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Rev. 07/10/02

Illinois Environmental Protection Agency

Southeast Rockford Source Control Operable Unit Focused Feasibility Study Volume II of III

September 5, 2000

Final

Project Number: 1681

Report

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276

THOMAS V. SKINNER, DIRECTOR

MEMORANDUM

DATE: February 20, 2001

TO: Bureau File (for insert into September 5, 2000 Feasibility Study, Volume 2)

FROM: Jerry Willman

SUBJECT: Minor changes to original document

SITE NUMBER: 2010300074 Winnebago
Southeast Rockford Groundwater Contamination
Superfund/Technical

This memorandum is intended to amend **Volume III** of the Source Control Operable Unit (OU3) Feasibility Study Report dated September 5, 2000, and shall be inserted beneath the front cover of the report within the Bureau file and site repositories.

Following the completion of the Feasibility Study, several alternatives described within the report have been slightly modified affecting the final cost for that alternative. Volume III Appendix D contains detailed cost information for each alternative. Two alternatives were slightly modified and therefore, the associated tables were modified as well. Each modified table is identified below and attached to this memorandum.

Changes to Volume II: Appendix D

Replace	Replace existing Table 7-4, Detailed Cost Estimate Table, and Comments Table with amended tables that are attached to this memorandum.

Replace	Replace existing Table 7-17, Detailed Cost Estimate Table, and Comments Table with amended tables that are attached to this memorandum.

TABLE 7-4
SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT
ROCKFORD, ILLINOIS
FEASIBILITY STUDY

SOURCE AREA 4
ATIVE SCS-4D REVISED 1: PARTIAL DEMOLITION, EXCAVATION, AND ON-SITE THERMAL TREATMENT
COST SUMMARY

Item/Description	Total Cost
CAPITAL COSTS	
General	$52,000
Demolition/ Construction	$99,000
Excavation / On-Site Thermal Treatment	$719,000
Excavation Dewatering	$532,000
Post Treatment Sampling	$12,000
SUBTOTAL CONSTRUCTION COSTS [1]	**$1,414,000**
Bid Contingency (15%)	$212,000
Scope Contingency (15%)	$212,000
Engineering and Design (15%)	$212,000
Oversight/Health and Safety (5%)	$71,000
TOTAL CAPITAL COSTS	**$2,121,000**
ANNUAL OPERATING AND MAINTENANCE COSTS	
General Maintenance of Thermal Treatment System	$0
TOTAL ANNUAL COSTS	**$0**
REPLACEMENT COSTS	
TOTAL REPLACEMENT COSTS [2]	**$0**
PRESENT WORTH ANALYSIS	
Total Capital Costs (from above) [3]	$2,121,000
Present Worth Annual O&M Costs [4]	$0
Present Worth Replacement Costs	$0
TOTAL PRESENT WORTH	**$2,121,000**

(1) Capital costs for construction items do not include oversight fees, which are accounted for separately.
(2) Replacement costs include construction and oversight capital costs.
(3) Capital costs represent the present worth of the given alternative.
(4) Present worth of annual O&M costs is based on a 7% annual discount rate over a project life of 3 months.

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT - AREA 4
ALTERNATIVE SCS-4D REVISED 1: PARTIAL DEMOLITION, EXCAVATION, AND ON-SITE THERMAL TREATMENT
DETAILED COST ESTIMATE

COST COMPONENT	Unit	No. Units	Unit Cost	Capital Cost	Construction/ Installation Costs	Annual O&M Costs	Start-up & Baseline Costs
[illegible]				[illegible]	$0	$0	[illegible]
construction trailer (rental and delivery)	mo	3	$275	$825			
mobilization	ls	1	$10,000	$10,000			
demobilization	ls	1	$10,000	$10,000			
decon trailer	ea	1	$5,000	$5,000			
vehicle decon station	ea	1	$10,000	$10,000			
vehicle decon equipment	ea	1	$570	$570			
health and safety equipment	mo	3	$4,500	$13,500			
electrical power service supply	mo	3	$400	$1,200			
dust control	mo	3	$230	$690			
[illegible]							
Partial Demolition	cf	30,000	$0.25	$7,500			
Reconstruction of Factory	cf	30,000	$3.05	$91,500			
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
mobilization/demobilization	ls	1	$23,500	$23,500			
pad for staging	ls	1	$10,000	$10,000			
temporary enclosure (rental - 88' wide by 200' long)	mo	3	$9,563	$28,689	$60,000		
excavation	ton	12,579	$5.00	$62,895			
soil treatment	ton	4,080	$53.00	$216,240			
backfill and compaction	ton	12,579	$2.00	$25,158			
water supply (10 GPM)	mo	3	$1,500	$4,500			
sheet piling	lf	360	$800	$288,000			
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
Completely furnish, install, operate, and remove system: well points spaced 20' O.C	mo	1	$250,000		$250,000		
analysis	batch	52	$1,000	$52,000			
T&D cost (15 GPM produced)	gallon	1,132,900	$0.20	$226,580			
rental of (2) 21,000 gallon tanks	mo	3	$1,000	$3,000			
[illegible]				[illegible]	$0	$0	$0
Analytical for Volatile Organic Compounds (soils)	ea	58	$200	$11,600			
shipping and handling	ea	4	$50	$200			

In general, a bulk density of 1.5 tons/yd^3 was assumed for soils material - this conversion was used for conversion of pricing giving per ton, where volume of material is given in yd^3.

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT - AREA 4
ALTERNATIVE SCS-4D REVISED 1: PARTIAL DEMOLITION, EXCAVATION, AND ON-SITE THERMAL TREATMENT
DETAILED COST ESTIMATE

COST COMPONENT	Unit	No. Units	Unit Cost	Capital Cost	Construction/ Installation Costs	Annual O&M Costs	Start-up & Baseline Costs
General				$51,785	$0	$0	$0
construction trailer (rental and delivery)	mo	3	$275	$825			
mobilization	ls	1	$10,000	$10,000			
demobilization	ls	1	$10,000	$10,000			
decon trailer	ea	1	$5,000	$5,000			
vehicle decon station	ea	1	$10,000	$10,000			
vehicle decon equipment	ea	1	$570	$570			
health and safety equipment	mo	3	$4,500	$13,500			
electrical power service supply	mo	3	$400	$1,200			
dust control	mo	3	$230	$690			
[illegible]				$98,000	$0	$0	$0
Partial Demolition	cf	30,000	$0.25	$7,500			
Reconstruction of Factory	cf	30,000	$3.05	$91,500			
Excavation and On-Site Thermal Treatment				$185,962	$60,000	$0	$0
mobilization/demobilization	ls	1	$23,500	$23,500			
pad for staging	ls	1	$10,000	$10,000			
temporary enclosure (rental - 88' wide by 200' long)	mo	3	$9,563	$28,689	$60,000		
excavation	ton	12,579	$5.00	$62,895			
soil treatment	ton	4,080	$53.00	$216,240			
backfill and compaction	ton	12,579	$2.00	$25,158			
water supply (10 GPM)	mo	3	$1,500	$4,500			
sheet piling	lf	360	$800	$288,000			
Excavation Dewatering (well points)				$381,980	$250,000	$0	$0
Completely furnish, install, operate, and remove system well points spaced 20' O.C.	mo	1	$250,000		$250,000		
analytical	batch	52	$1,000	$52,000			
T&D cost (15 GPM produced)	gallon	1,132,900	$0.20	$226,580			
rental of (2) 21,000 gallon tanks	mo	3	$1,000	$3,000			
Post Treatment Sampling				$11,800	$0	$0	$0
Analytical for Volatile Organic Compounds (soils)	ea	58	$200	$11,600			
shipping and handling	ea	4	$50	$200			

In general, a bulk density of 1.5 tons/yd^3 was assumed for soils material - this conversion was used for conversion of pricing giving per ton, where volume of material is given in yd^3.

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT - AREA 4
ALTERNATIVE SCS-4D REVISED 1: PARTIAL DEMOLITION, EXCAVATION, AND ON-SITE THERMAL TREATMENT
DETAILED COST ESTIMATE - COMMENTS

COST COMPONENT	COMMENTS
General	
construction trailer (rental and delivery)	50'x12' construction trailer - $1.65/mi delivery fee (100mi) - rental allowance per 1996 Means
mobilization	Heavy equipment and trailers, per vendor estimate
demobilization	Allowance for trailer and equipment demobilization
decon trailer	Allowance based on CDM equipment rates
vehicle decon station	20'x20' gravel pad over 11 mil plastic with plywood and joist deck per 1996 Means
vehicle decon equipment	Steam cleaning and water tank per 1996 Means
health and safety equipment	Allowance based on CDM equipment rates
electrical power service supply	Based on expected electrical costs per month for this alternative
dust control	Water truck per 1996 Means
Demolition	
Partial Demolition	Building Demolition, large urban projects, mixture of material types per Means 1999
Reconstruction of Factory	Average Factory construction costs per Means 1999
Excavation and On-Site Thermal Treatment	
mobilization/demobilization	Transportation of the Indirect Heat and Volatilization unit (IHV), frontloader, and the time involved for set-up and tear-down (vendor estimate)
pad for staging	Pad size approx. 200'x200' crushed stone or asphalt (vendor estimate)
temporary enclosure (rental - 88' wide by 200' long)	Sprung Instant Structure - vendor estimate; constr/install costs include labor and heavy equip
excavation	Excavation cost (vendor estimate)
soil treatment	Vendor Estimate for Direct Fired Low Temperature Thermal Desorption (includes providing a loader and operator to place contaminated soil into the cold feed bin and for restockpiling the clean processed soil);
backfill and compaction	Backfill and compaction of clean soil from stockpiling (vendor estimate)
water supply	10 GPM is needed for operation of the thermal treatment system (4,800 gpd if run for 8hrs/day), costs based on construction site water average per 1996 Means - typical
sheet piling	steel sheets, approx. 4' x 40' around perimeter of excavation; as per CDM experience
Excavation Dewatering (well points system)	
Completely furnish, install, operate, and remove system well points spaced 20' O.C.	Based on vendor estimate - MoreTrench Amencan (June 1998); System operation 24 hours/day, 7 days/week with diesel pumps
analytical	Based on CDM Experience
T&D cost (15 GPM produced)	Based on CDM Experience
rental of (2) 21,000 gallon tanks	Based on CDM Experience
Post-Treatment Sampling	
Analytical for Volatile Organic Compounds (soils)	Based on 1998 sample analysis costs from Midwest laboratories; samples collected on a grid of 1 sample/250cy, 1 sampling grid per month (including QA/QC samples)
shipping and handling	Costs associated with transporting samples from site to laboratory twice per month

TABLE 7-17

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT
FOCUSED FEASIBILITY STUDY
ROCKFORD, ILLINOIS

AREA 4 - LEACHATE
ALTERNATIVE SCL-4B: LIMITED ACTION / LEACHATE MONITORING / LEACHATE COLLECTION AND TREATMENT BY AIR STRIPPING UNIT / OFF-SITE SURFACE WATER DISCHARGE / GROUNDWATER USE RESTRICTIONS
COST SUMMARY

Item/Description	Total Cost
CAPITAL COSTS	
Groundwater Use Restrictions	$25,000
Leachate Containment System	$118,000
Leachate Monitoring Wells	$18,000
SUBTOTAL CONSTRUCTION COSTS [1]	**$161,000**
Bid Contingency (15%)	$24,000
Scope Contingency (20%)	$32,000
Engineering and Design (15%)	$24,000
Oversight/Health and Safety (5%)	$8,000
TOTAL CAPITAL COSTS	**$249,000**
ANNUAL OPERATING AND MAINTENANCE COSTS	
Leachate Containment System	$7,000
Granular Activated Carbon	$31,000
Leachate Containment System Sampling and Analysis (per event)	$4,000
Leachate Sampling and Analysis (per event)	$5,000
TOTAL ANNUAL COSTS	**$47,000**
REPLACEMENT COSTS [2]	
Leachate Containment System (every 15 years)	$78,000
Monitoring Well Replacement (every 15 years)	$29,000
TOTAL REPLACEMENT COSTS	**$107,000**
PRESENT WORTH ANALYSIS	
Total Capital Costs (from above) [3]	$249,000
Present Worth Annual O&M Costs [4]	$472,000
Leachate Containment System	
Quarterly Sampling - years 1 through 30	$200,000
Leachate Monitoring Wells	
Quarterly Sampling - years 1 and 2	$37,000
Semi-annual Sampling - years 3 through 30	$106,000
Present Worth Replacement Costs [5]	$53,000
TOTAL PRESENT WORTH	**$1,117,000**

(1) Capital costs for construction items do not include oversight fees.
(2) Replacement costs include construction *and* oversight capital costs.
(3) Capital costs represent the present worth of the given alternative.
(4) The "Present Worth Annual O&M Cost" line item includes all annual costs except for costs per sampling and analysis event. Costs incurred for sampling and analysis are broken down per sampling schedule as listed. Sampling and analysis costs are based on a 7% discount rate over a 30 year projection (Based on RCRA Closure Guidelines).
(5) Present worth of replacement costs is based on a 7% annual discount rate and replacement of monitoring wells replacement and leachate collection system (including extraction wells, piping, pumps, and air stripping unit) every 15 years.

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT
AREA 4 - LEACHATE
ALTERNATIVE SCL-4B: LIMITED ACTION / LEACHATE MONITORING / LEACHATE COLLECTION AND TREATMENT BY AIR STRIPPING UNIT / OFF-SITE SURFACE WATER DISCHARGE / GROUNDWATER USE RESTRICTIONS
DETAILED COST ESTIMATE

COST COMPONENT	Unit	No. Units	Unit Cost	Capital Cost	Construction/ Installation Costs	Annual O&M Costs	Start-up & Baseline Costs
[illegible]				[illegible]			
Legal Fees	ls	1	$25,000	$25,000			
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
mobilization/demobilization	ls	1	$9,000	$9,000			
treatment building	ft^2	400	$100	$40,000			
electrical supply	ls	1	$5,000	$5,000			
extraction well installation	well	4	$5,800		$23,200		
pump materials and installation	pump	6	$1,180	$7,080	$600	$2,000	
4" dia. carbon steel header pipe	feet	20	$32	$640			
6" dia. carbon steel header to air stripper pipe	feet	150	$57	$8,550			
air stripping treatment unit installation and materials	ls	1	$15,500	$15,500	$3,000	$5,000	
6" carbon steel air stripping unit discharge pipe	feet	200	$25	$5,000			
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
Regeneration	ea	19.00	$785			$14,915	
Disposal	lb	3230	$3			$8,075	
Sampling	ea	19.00	$400			$7,600	
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
well installation and materials	well	4	$4,500		$18,000		
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
labor	hours	10	$60			$600	
vehicle	day	1	$60			$60	
equipment	ls	1	$600			$600	
miscellaneous	ls	1	$1,000			$500	
leachate treatment system laboratory analysis	each	2	$1,000			$2,000	
[illegible]				[illegible]	[illegible]	[illegible]	[illegible]
labor	hours	40	$60			$2,400	
vehicle	day	2	$60			$120	
equipment	ls	1	$600			$600	
miscellaneous	ls	1	$1,000			$500	
leachate laboratory analysis	each	8	$130			$1,040	

[illegible]

(1) The monitoring schedule over 30 years was assumed as
Years 1,2 = quarterly sampling Years 3 through 30= semi-annual sampling (Based on RCRA Closure Guidlines)
These costs are incorporated in each alternative's cost summary under "Annual Operation and Maintenance"

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT
AREA 4 - LEACHATE
ALTERNATIVE SCL-4B: LIMITED ACTION / LEACHATE MONITORING / LEACHATE COLLECTION AND TREATMENT BY AIR STRIPPING UNIT / OFF-SITE SURFACE WATER DISCHARGE / GROUNDWATER USE RESTRICTIONS
DETAILED COST ESTIMATE - COMMENTS

COST COMPONENT	COMMENTS
legal fees	Cost based on CDM experience
mobilization/demobilization for all	Cost based on CDM experience
treatment building	Based on a 20 foot x 20 foot building - cost based on Means Building Construction Cost Data
electrical supply	Based on CDM experience
extraction well installation	4" diameter, stainless steel construction, 35 foot depth with 10 foot screen - cost based on CDM experience of average extraction well installation costs.
pump installation	1 pump per well (2 spare) @ 1.2 to 7 gpm flow with/control box each pump - costs based on April 1998 Grundfos cost estimate
4" dia. well connected to main pipe	4" diameter carbon steel pipe, 10 foot linkages from each of the 4 wells to treatment unit (with 15% contingency) - cost based on CDM experience
6" dia. pipe connected to air stripping unit	4" diameter carbon steel pipe, header pipe (with 15% contingency) for connection between each well and leachate treatment unit - cost based on CDM experience
air stripping treatment unit	Shallow Tray air stripper model 1321 with options - cost based on April 1998 North East Environmental Products, Inc. cost estimate
leachate discharge pipe	6" diameter carbon steel pipe, 10 foot linkages from treatment unit to off-site surface water discharge (with 15% contingency) - cost based on CDM experience
well installation and materials	Cost based on CDM experience in monitoring well installation
labor	Based on 10 hour work day at the average CDM labor rate of $60 for oversite personnel
vehicle	Based on $60/day rental fee for a field vehicle
equipment	Based on CDM equipment rental rates
miscellaneous	Incidental expenses (minor repairs, replacement of equipment, local purchases, etc)
leachate treatment system laboratory analysis	Based on average cost incurred for priority pollutants analysis; One duplicate and one blank will be collected per 10 samples.
labor	Based on 10 hour work day at the average CDM labor rate of $60 for oversite personnel
vehicle	Based on $60/day rental fee for a field vehicle
equipment	Based on CDM equipment rental rates
miscellaneous	Incidental expenses (minor repairs, replacement of equipment, local purchases, etc)
leachate laboratory analysis	Based on average cost incurred for VOCs; One duplicate and one blank will be collected per 10 samples.

Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations

Abbreviation	
1,1,1-TCA	1,1,1-Trichlorethane
1,2-DCA	1,2-Dichloroethane
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
BRA	Baseline Risk Assessment
BETX	Benzene, Ethylbenzene, Toluene, and Xylene
CAA	Clean Air Act
CDM	Camp Dresser & McKee
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm/s	Centimeters per second
COPC	Contaminant of Potential Concern
CWA	Clean Water Act
DCA	Dichloroethane
DCE	Dichloroethene
DNAPL	Dense Non-Aqueous Phase Liquid
ERSV	Exposure Route Specific Values
ETX	Ethylbenzene, Toluene, and Xylene
FFS	Focused Feasibility Study
FOC	Fraction of Organic Carbon
GMZ	Groundwater Management Zone
gpm	Gallons per Minute
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Act Amendments of 1984
HWIR	Hazardous Waste Identification Rule
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
IGWPA	Illinois Groundwater Protection Act
IRIS	Integrated Risk Information System
IDW	Investigation Derived Wastes
ISWS	Illinois State Water Survey
LDRs	Landfill Disposal Restrictions
LNAPL	Light Non-Aqueous Phase Liquid
kg	Kilogram
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter

TOC	Total Organic Carbon
TSCA	Toxic Substance Control Act
UCL	Upper Confidence Limit
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound

APPENIX A

RISK ASSESSMENT REPORTS

CDM Camp Dresser & McKee

Illinois Environmental Protection Agency

Southeast Rockford Source Control Operable Unit Risk Assessment Report

Final
April 11, 2000

Report

Contents

Figures

Tables

Executive Summary

A risk assessment was conducted on the Southeast Rockford Source Control Operable Unit (SCOU) study area. The study area contains four separate source areas - Areas 4, 7, 9/10, and 11. A risk assessment was conducted in order to develop soil remediation objectives for each of these four source areas. The risk assessment followed a tiered approach, in conformance with Tiered Approach to Corrective Action Objectives (TACO): 35 ILL.ADM.CODE PART 742. TACO is a set of State of Illinois regulations that specify methods for developing remediation objectives and identifying chemicals of concern. TACO also provides guidance on associated issues such as the statistical evaluation of data, the collection and use of background data, and the establishment of compliance points.

TACO uses a three-tiered approach to identify chemicals of concern and develop remediation objectives for those chemicals. TACO's first tier (Tier 1) is a set of tables listing pre-established screening values. These screening values can be used as soil remediation objectives, or, for those chemicals with concentrations higher than the screening values, site-specific soil remediation objectives can be calculated using the methods and procedures described in Tier 2 or Tier 3. A combination of Tier 1 and 3 was used in this risk assessment. The soil remediation objectives and conclusions reached in this risk assessment will be the basis for the feasibility study (study of site remedies) so that the chemical concentration levels remaining after the remedy is in place will meet the United States Environmental Protection Agency (USEPA) requirements for protection of human health and the environment as described in 40 CFR 300.430 (e)(2) of the National Contingency Plan.

Three exposure pathways were considered in this assessment: (1) direct contact with soil (including ingestion and inhalation); (2) the soil component of the groundwater ingestion pathway; and (3) ingestion of vegetables. A Tier 1 evaluation was conducted for the direct contact with soil pathway and the soil component of the groundwater pathway. A Tier 3 evaluation was also conducted for the soil component of the groundwater pathway (for chemicals which exceeded Tier 1 values) and the ingestion of vegetables pathway.

The groundwater component of the groundwater ingestion pathway was previously addressed in the September 1995 Record of Decision (ROD). A separate risk assessment was prepared to address that pathway.

Sampling data collected from surface and subsurface soil from each of the four source areas were compared to the Tier 1 Exposure Route-Specific Values (ingestion and inhalation) (ERSVs) for soil protective of residential areas and the Soil Component of the Groundwater Ingestion Exposure Route Values (SCGVs) for Class I groundwater. The ERSVs are protective of direct contact with soil, while the SCGVs are protective of groundwater impacted by contaminants that could leach from soil. As directed by Illinois Environmental Protection Agency (EPA), it was assumed that all four source areas were, or could become, residential areas.

Because several chemicals exceeded Tier 1 objectives for soil that could impact groundwater, Tier 3 soil remediation objectives (SRO) were developed. The SRO is back- calculated from the Groundwater Remediation Objective (GRO) presented for class I Groundwater in section 742, Appendix B: Table F of TACO. While most of the GRO's are based on a hazard index of 1.0 or a cancer risk of one in one million, in some cases, the GRO is based on a higher cancer risk. A mixtures assessment was conducted according to the IEPA mixture rule issued under Docket C of the Illinois Pollution Control Board (December 4, 1997) to determine what the risks would be if all of the SROs for the soil to groundwater pathway were achieved. This assessment presented in Section 4.2, demonstrates that, in accordance with TACO, total cancer risk associated with the SROs for the soil to groundwater pathway would not exceed an excess lifetime risk of one in ten thousand or a hazard index of 1.0 if all SROs were achieved.

Result of the Direct Contact Pathway

The results of the assessment of the direct contact pathway can be summarized as follows:

1. Maximum concentrations of volatile organic compounds (VOCs) did not exceed their respective Tier 1 values in any of the focus areas.

2. Maximum concentrations of semi-volatile organic compound (SVOCs) and inorganics exceeded their respective ERSV Tier 1 values in all four areas.

3. Maximum concentrations of inorganic and one SVOC in area 7, benzo (a) pyrene, were dropped from further evaluation because detected concentrations were less than or consistent with background concentrations. Risk associated with these chemicals are below 1E-06 (one in one million) and/or a hazard index of 1.0.

4. Selected samples in Areas 4 (SS4-201, SS4-203, SS4-203D) and 11 (SS11-206, SS11-207) were identified as hot spots that exceeded a Tier 1 value and the Practical quantitation limit (PQL). Three out of four samples in Area 9/10 (SS910-101, SS910-103, SS910-104) exceeded one or more Tier 1 values. These data are presented in Appendix B. The hot spots in Areas 4 and 11 and the samples exceeding a Tier 1 value in Area 9/10 will be addressed in the Feasibility Study. The Feasibility study will evaluate whether or not additional SVOC data may be needed in the remedial design phase to better characterize risk and the extent of contamination. Based on the results of sampling, if necessary, remedial alternatives that address SVOCs would be developed and evaluated. The presence of these hot spots represents a potential exceedance of risk limits established by USEPA (a noncancer hazard index of 1.0 and cancer risks of between one in one million and one in one

hundred thousand) and Illinois EPA (a noncancer index of 1.0 and cancer risks of one in one million used to develop the Tier 1 values) depending on actual exposure.

Result of the Soil to Groundwater Pathway

The results of the assessment of the soil to groundwater pathway can be summarized as follows:

1. Several chemicals were dropped from further evaluation for the soil to groundwater pathway because they were not detected in groundwater (Dieldrin, carbazole and several SVOCs).

2. VOCs in surface soil in area 4 and VOCs in subsurface soil in all four areas exceeded Tier 1 SCGV values. These VOCs were further evaluated in Tier 3.

A Tier 3 assessment was conducted for those chemicals that exceeded a SCGV and were detected in groundwater during past sampling events at greater than 5 percent frequency of detection. The Tier 3 assessment consisted of calculating soil concentration protective of groundwater at a designated point of compliance

Result of the Soil Component of the Groundwater Ingestion Pathway

The results of the assessment of the soil component of the groundwater ingestion pathway can be summarized as follows:

1. Chemicals of concern in Areas 4, 7, and 11 exceed their respective SROs. Two additional chemicals of concern in Area 11 exceed their respective saturation concentrations, but not the calculated SRO. Risks associated with chemicals that exceed a SRO in areas 4, 7 and 11 exceed Illinois EPA cancer risk limits of one in one million or a hazard index of 1.0.

1. All areas where detected concentrations exceeded the lower of the SRO or saturation concentration were further evaluated in the Feasibility Study Volumes estimates were developed for these areas for excavation or remediation purposes.

Results of Homegrown Fruits and Vegetable Ingestion Pathway

Area 7 borders land currently used for agricultural purposes, and no current zoning restrictions prevent conversion of some of the undeveloped portions of Area 7 to agricultural use. For these reasons, a semi-quantitative evaluation was conducted to determine whether the use of Area 7 for growing vegetables or fruits would result in an unacceptable risk to human health.

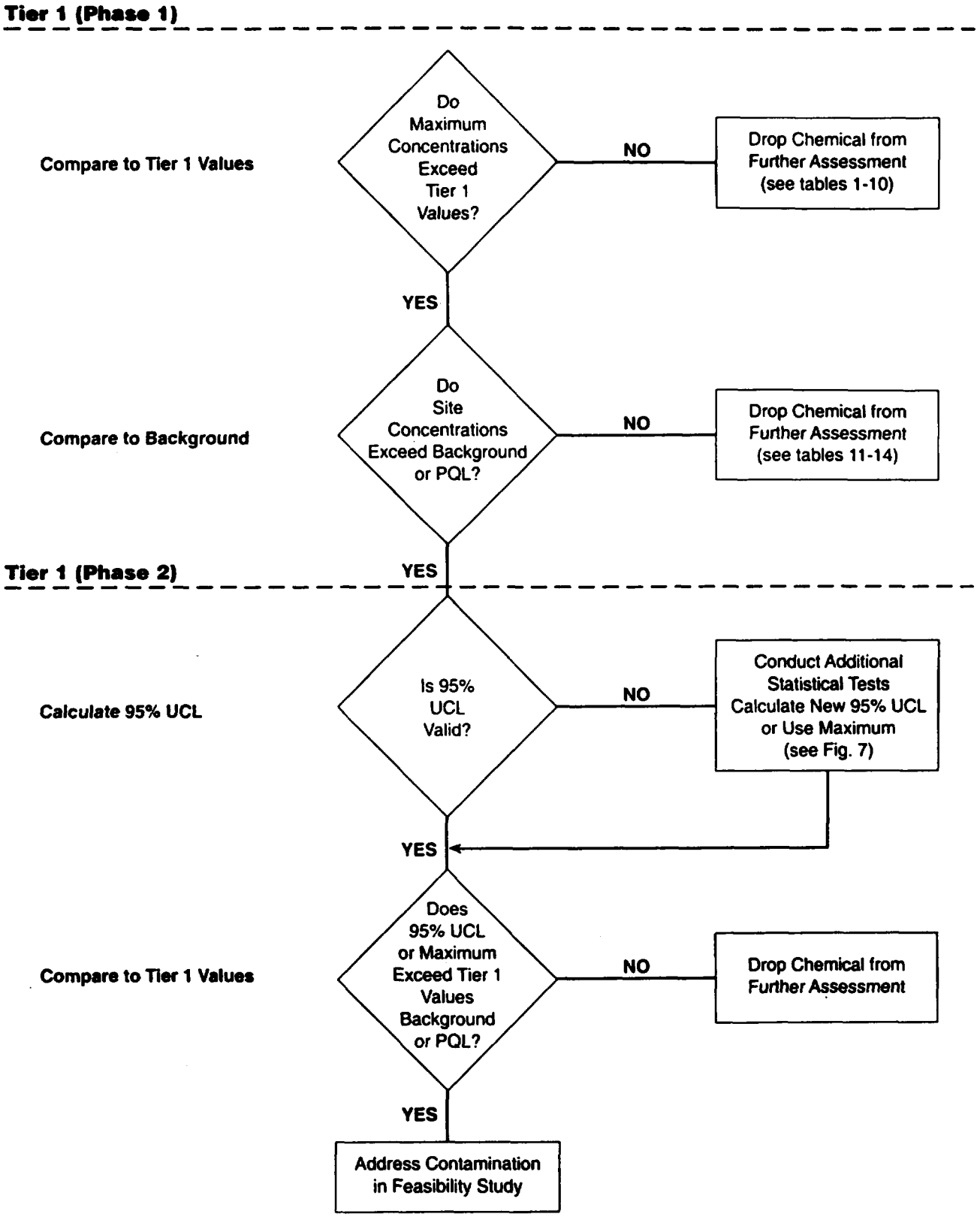
Based on this evaluation, it is concluded that ingestion of vegetables (or fruits which have a fresh weight consumption rate lower than vegetables, i.e., 88 mg/day) would not result in exceedance of either a hazard index of 1.0 or a cancer risk of 1E-06 (one in one million), which are the risk limits on which the Tier 1 values are based.

Section 1
Introduction

The Southeast Rockford Source Control Operable Unit (SCOU) study area contains four separate source areas - Areas 4, 7, 9/10, and 11. A description of these areas is provided in the Focused Feasibility Study. A risk assessment was conducted in order to develop soil remediation objectives for each of these four source areas. The risk assessment followed a tiered approach, in conformance with Tiered Approach to Corrective Action Objectives (TACO): 35 ILL.ADM.CODE PART 742. TACO specifies a three-tiered approach, and any, or all three tiers can be used. Tier 1 involves a comparison of chemical concentrations found at the site to pre-established screening values protective of three exposure pathways: (1) incidental ingestion of soil; (2) inhalation of chemicals that could volatilize from soil to ambient air; and (3) the soil component of the groundwater ingestion exposure route, i.e., leaching from soil to groundwater that could be used for drinking water. The first two exposure pathways will be referred to as the "direct contact" pathway. The screening values found in Tier 1 can be used as remediation objectives, or, for those chemicals with concentrations higher then the screening values, site-specific soil remediation objectives can be calculated using the methods and procedures described in Tier 2 or Tier 3. A combination of Tiers 1 and 3 were used in this risk assessment.

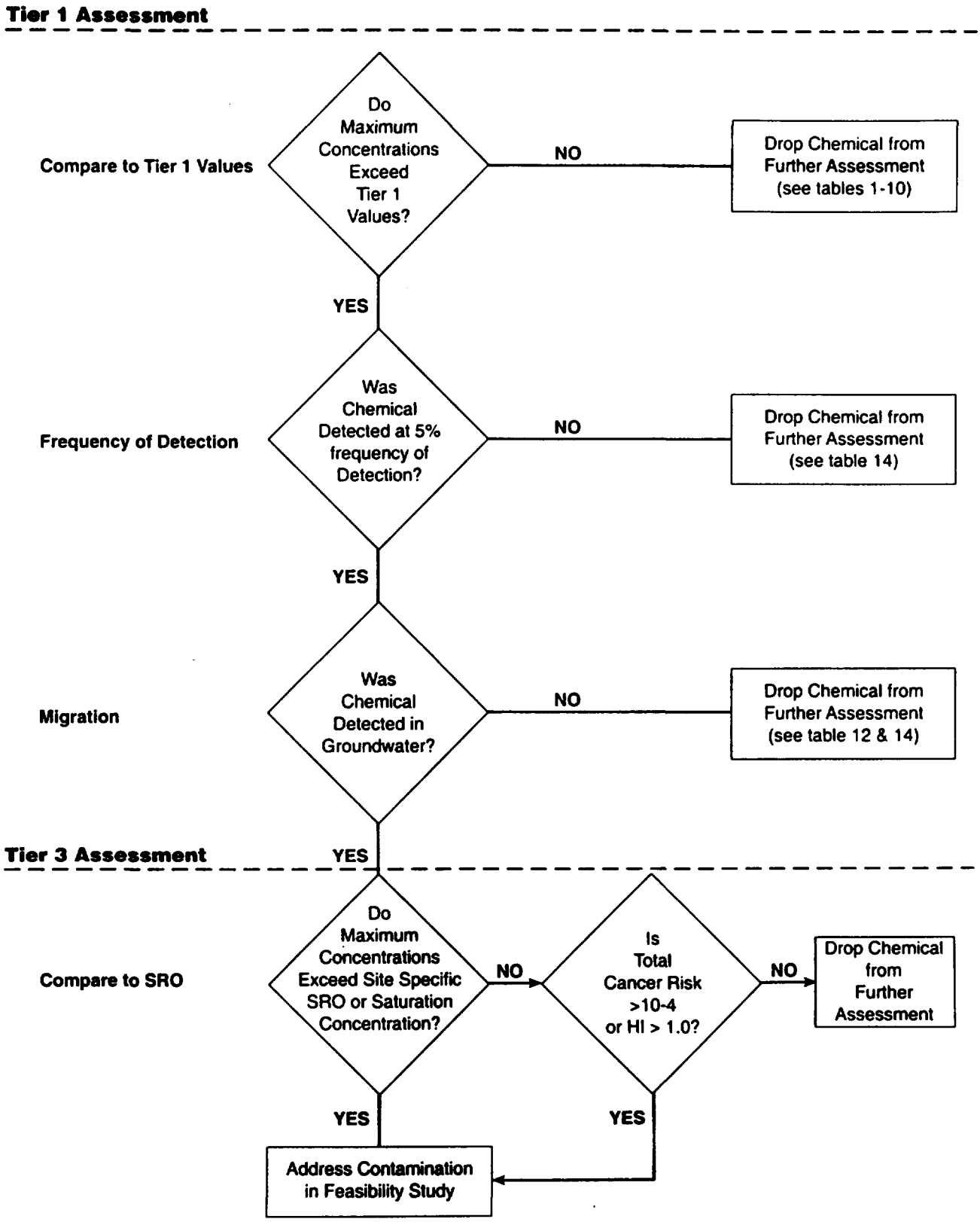
Chemical concentrations found at the site were compared to a combination of Tier 1 pre-established screening values, background concentrations and practical quantitation limits (PQLs). A PQL is the level at which a chemical can be reliably measured in the laboratory. The direct contact pathway and the soil to groundwater ingestion pathway were both evaluated in this matter. In addition, for the soil to groundwater ingestion pathway, Tier 3 was used to develop site-specific remediation objects for those chemicals whose concentrations exceeded values established under the Tier 1 assessment. **Figure 1** summarizes the Tier 1 assessment that was conducted for the direct contact pathway. **Figure 2** summarizes the assessment for the soil to groundwater ingestion pathway, which involved both Tiers 1 and 3.

Tier 3 was also used to evaluate ingestion of vegetables as part of a potential agricultural exposure scenario for Area 7. Based on land use in this area, the close proximity of farmland, and the absence of institutional controls, it was determined that an agricultural scenario could not be ruled out. Exposures associated with an agricultural scenario would be essentially the same as those associated with a residential scenario with the addition of potential ingestion of homegrown vegetables. Residential land use may also include ingestion of homegrown vegetables, however the Tier 1 values do not specifically address this pathway. For this reason, this pathway was evaluated separately as part of the Tier 3 assessment.



Southeast Rockford Source Control Operable Unit

Figure 1
Tier 1 Assessment for the Direct Contact Pathway



Southeast Rockford Source Control Operable Unit

Figure 2

Tier 3 Assessment for the Soil to Groundwater Pathway

Section 2
Scope

Three exposure pathways were considered in this assessment: (1) direct contact with soil; (2) the soil component of the groundwater ingestion pathway; and (3) ingestion of vegetables. The groundwater component of the groundwater ingestion pathway was previously addressed in the September 1995 Record of Decision (ROD). A separate risk assessment was prepared to address that pathway. This assessment was based on soil data and information collected during the Phase II Site Investigation and the SCOU Investigation. Soil gas and groundwater data were also used to determine the extent of contaminant migration and completeness of certain exposure pathways.

In 1993, on behalf of Illinois EPA, Camp Dresser & McKee conducted indoor and outdoor air sampling was conducted at 18 homes in Areas 4 and 7. In general, the chemicals and concentrations detected were typical of background conditions in indoor and outdoor air. Providing further evidence that indoor air concentrations did not originate from site contamination, soil gas concentrations were below detection limits in Area 7 beyond the immediate source area and in the portion of the site closed to residences. In Area 4, soil gas concentrations were elevated in the vicinity of Swebco Mfg. Inc.; however, residences in this area do not have basements. Infiltration of soil gas to indoor air is, therefore, not problematic for these homes. Two homes exhibited indoor air concentration above typical background concentration. At one of these homes, the homeowner explained to an official of the Illinois Department of Public Health that a sump located in the basement, which was likely the primary reason for the elevated indoor air concentrations, had been plugged following the indoor sampling event. The other home did not have a basement. For homes without basements, chemicals detected in indoor air are not likely to be associated with subsurface contamination. In Remedial Investigation Report Southeast Rockford Groundwater Contamination Study (CDM, June 1994), all concentrations detected in indoor air were found to be below risk-based concentrations.

Indoor air sampling was not conducted in Areas 9/10 and 11 because these areas are primarily industrial/commercial. No chemicals were detected in soil gas in Area 11 in these portions of the Area closest to residences. Soil gas concentrations of total chlorinated VOCs detected in Area 9/10 were below detection limits in those portions of the area closest to residences. Soil gas concentrations of benzene, toluene, ethyl benzene, and xylene (BTEX) were low to below detection limits. BTEX is ubiquitous in soil gas due to surface runoff that infiltrates the subsurface. The low concentrations of BTEX detected in soil gas in Area 9/10 were likely related to surface run off and not related to site wide contamination. For these reasons, conditions in Area 9/10 did not warrant indoor air sampling.

Sampling data collected from surface and subsurface soil from each of the four operable units were compared to the Tier 1 Exposure Route-Specific Values (ingestion and inhalation) (ERSVs) for soil protective of residential areas and the Soil Component of the Groundwater Ingestion Exposure Route Values (SCGVs) for Class I

groundwater. The ERSVs are protective of direct contact with soil, while the SCGVs are protective of groundwater impacted by contaminants that could leach from soil.

As directed by Illinois EPA, it was assumed that all four source areas were, or could become, residential areas. Currently, no land use restrictions are in place to prevent residential development or expansion, therefore, it was necessary to employ soil remedial objectives that would be protective of residential land use. Because the exposure assumptions for the residential scenario are standardized, with few site-specific modifications, there was no advantage to developing Tier 3 objectives for the residential scenario and Tier 1 values were used.

While a city ordinance is in place prohibiting the construction of new wells, private wells still exist within Southeast Rockford. For this reason, groundwater, beyond the active groundwater management zones (GMZ) in each area, will be protected to drinking water standards. Within the GMZ, active remediation will be taking place. The edge of the GMZ will be the point of compliance for groundwater. Because several chemicals exceeded Tier 1 objectives for soil that could impact groundwater, Tier 3 soil remediation objectives were developed. Soil objectives were developed to be protective of groundwater at the edge of the GMZ. As required by TACO, soil remediation objectives protective of the groundwater pathway are back calculated from the groundwater objective presented in Section 742, Appendix B, Table F. While most of the groundwater objectives are based on a hazard index of 1.0 or a cancer risk of one in one million, in some cases, the groundwater objective is based on a higher cancer risk. A mixtures assessment was conducted according to the Illinois EPA mixture rule issued under Docket C of the Illinois Pollution Control Board (December 4, 1997) to determine risks if all of the SROs for the soil to groundwater pathway were achieved. This assessment, presented in Section 4.2, demonstrates that, in accordance with TACO, total cancer risk associated with the SROs for the soil to groundwater pathway would not exceed an excess lifetime risk of one in ten thousand or a hazard index of 1.0. if all SROs were achieved.

Section 3
Tier 1 Assessment

TACO is a step-wise procedure for determining chemicals of concern and developing cleanup objectives for those chemicals. While the tiered approach presents specific methods for selecting or developing remediation objectives, detailed guidance is also presented on associated issues such as the statistical evaluation of data, collecting and using background data, and establishing points of compliance. The procedures used in this assessment were derived from the TACO regulations and guidance. In addition, Illinois EPA staffs were consulted for guidance on several issues that were not specifically addressed in the TACO regulations. Tier 1 was conducted in two phases. In phase 1, both the direct contact pathway and the soil to groundwater ingestion pathway were evaluated. Phase 2 examined only the direct contact pathway.

3.1 Tier 1 - Phase 1

Tier 1 -Phase 1 evaluates both the direct contact pathway and the soil to groundwater ingestion pathway. The Tier 1 assessment involved the following steps:

1. Compile sampling and analysis data collected during the Phase I and SCOU sampling events.
2. Segregate data into surface (0-3 feet) and subsurface (>3 feet) soil samples. Segregate subsurface data into data sets representing soil between three and ten feet and below ten feet.
3. Summarize sampling and analysis data (range of detected concentrations, frequency of detection).
4. Compare maximum concentrations to Tier 1 values and identify exceedances of ERSVs or SCGVs.
5. Compare chemicals to background concentrations reported in TACO and site-specific background.

Tables 1 through 10 summarize the soil data collected from the four source areas. The data were segregated into three strata: (1) surface soil data (0-3 feet); (2) subsurface soil data between three and ten feet; and (3) subsurface soil data below ten feet. The data were segregated this way to reflect the different exposures that could occur at different soil depths. Tables 1 through 4 present surface soil data for all four areas; Tables 5 and 6 present subsurface soil data between three and ten feet for Areas 4 and 7. No subsurface soil samples between three and ten feet were collected from Areas 9/10 and 11. Tables 7 through 10 present subsurface soil data below ten feet for all four areas. Consistent with TACO guidance, residential exposure to soil could occur from the surface to a depth of ten feet. Surface soil data and subsurface soil data above ten feet were compared to the Tier 1 ERSVs as well as to the SCGVs for the protection of residential areas and Class I groundwater. Subsurface soil data below

Table 1
S.E. Rockford Source Area Risk Assessment - Area 4 Surface Soil

Parameter	Surface Soil - Area 4					
	Range of Detected Concentrations	Proportion of Samples With Detections		Residential Soil Objective (Lower of inhal/inges)	Soil Component of GW Ingestion Route Values	Background
Volatile Organics (ug/kg)						
Methylene Chloride	12 - 18	2 / 8	(25%)	13,000	20	
1,2-Dichloroethene (total)	3 - 3	1 / 8	(13%)	780,000 (3)	400	
1,2-Dichloroethane	17 - 17	1 / 8	(13%)	400	20	
1,1,1-Trichloroethane	7 - 110	2 / 8	(25%)	1,200,000	2,000	
1,2-Dichloropropane	1 - 2	2 / 8	(25%)	9,000	30	
Trichloroethene	25 - 25	1 / 8	(13%)	5,000	60	
Toluene	3 - 11	2 / 8	(25%)	650,000	12,000	
Semivolatile Organics (ug/kg)						
Naphthalene	49 - 260	3 / 8	(38%)	3,100,000	84,000	297
2-Methylnaphthalene	58 - 120	3 / 8	(38%)	NA	NA	297
Acenaphthene	850 - 960	2 / 8	(25%)	4,700,000	570,000	297
Dibenzofuran	420 - 550	2 / 8	(25%)	NA	NA	
Fluorene	720 - 920	2 / 8	(25%)	3,100,000	560,000	297
Phenanthrene	150 - 16,000	5 / 8	(63%)	NA	NA	446
Anthracene	50 - 1,000	4 / 8	(50%)	23,000,000	12,000,000	195
Carbazole	48 - ***1,400***	4 / 8	(50%)	32,000	600	
Di-n-Butylphthalate	51 - 100	5 / 8	(63%)	2,300,000	2,300,000	
Fluoranthene	44 - 12,000	8 / 8	(100%)	3,100,000	4,300,000	809
Pyrene	45 - 5,000	7 / 8	(88%)	2,300,000	4,200,000	670
Butylbenzylphthalate	60 - 180	3 / 8	(38%)	930,000	930,000	
Benzo(a)anthracene	53 - ***5,600***	5 / 8	(63%)	900	2,000	401
Chrysene	72 - 5,900	7 / 8	(88%)	88,000	160,000	431
bis(2-Ethylhexyl)Phthalate	300 - 9,000	8 / 8	(100%)	46,000	3,600,000	
Di-n-Octyl Phthalate	67 - 67	1 / 8	(13%)	1,600,000	10,000,000	
Benzo (b) Fluoranthene	67 - ***11,000***	8 / 8	(100%)	900	5,000	539
Benzo (k) Fluoranthene	70 - ***11,000***	8 / 8	(100%)	900	49,000	301
Benzo (a) Pyrene	97 - ***1,100***	5 / 8	(63%)	90	8,000	389
Ideno (1,2,3-cd) Pyrene	75 - 620	4 / 8	(50%)	900	14,000	317
Dibenzo (a,h) Anthracene	41 - ***430***	4 / 8	(50%)	90	2,000	297
Benzo (g,h,i) Perylene	56 - 70	2 / 8	(25%)	NA	NA	329
Pesticides & PCBs (ug/kg)						
delta-BHC	0.095 - 0.29	3 / 8	(38%)	NA	NA	
Aldrin	0.29 - 0.39	2 / 8	(25%)	40	500	
Heptachlor epoxide	0.52 - 2	3 / 8	(38%)	70	700	
Endosulfan I	0.13 - 0.13	1 / 8	(13%)	470,000	18,000	
Dieldrin	0.29 - 3.9	5 / 8	(63%)	40	4	
4,4'-DDE	0.83 - 3.9	4 / 8	(50%)	2,000	54,000	
Endrin	0.61 - 0.61	1 / 8	(13%)	23,000	1,000	
Endosulfan II	0.2 - 0.4	3 / 8	(38%)	470,000	18,000	
4,4'-DDD	0.13 - 4.3	6 / 8	(75%)	3,000	16,000	
4,4'-DDT	3.7 - 22	4 / 8	(50%)	2,000	32,000	
Methoxychlor	1.2 - 26	5 / 8	(63%)	390,000	160,000	
Endrin ketone	0.3 - 0.34	2 / 8	(25%)	23,000	1,000	
Endrin aldehyde	0.33 - 17	5 / 8	(63%)	23,000	1,000	
alpha-Chlordane	0.2 - 3.9	6 / 8	(75%)	500	10,000	
gamma-Chlordane	1.1 - 2.7	2 / 8	(25%)	500	10,000	
Aroclor-1254	8.4 - 49	4 / 8	(50%)	1,000	NA	
Aroclor-1260	100 - 100	1 / 8	(13%)	1,000	NA	
Inorganics (mg/Kg)						
Aluminum	2,550 - 11,500	8 / 8	(100%)	NA		9500
Antimony	7.3 - 7.6	2 / 8	(25%)	31		4
Arsenic	2.8 - ***6.2***	8 / 8	(100%)	0.4		7.2
Barium	27 - 216	8 / 8	(100%)	5,500		110
Beryllium	0.28 - ***0.7***	8 / 8	(100%)	0.1		0.6
Cadmium	0.43 - 7.4	7 / 8	(88%)	78		0.6
Calcium	2,590 - 131,000	8 / 8	(100%)	NA		9300
Chromium	5.4 - 57.5	8 / 8	(100%)	270		16.2
Cobalt	2.8 - 6.2	8 / 8	(100%)	4,700		8.9
Copper	7.8 - 148	8 / 8	(100%)	2,900		20
Iron	7,390 - 13,600	8 / 8	(100%)	NA		15900
Lead	15.1 - 112	8 / 8	(100%)	400		36
Magnesium	1,530 - 83,700	8 / 8	(100%)	NA		4820
Manganese	264 - 592	8 / 8	(100%)	3,700		636
Nickel	6.8 - 18.8	8 / 8	(100%)	1,600		18
Potassium	296 - 1140	8 / 8	(100%)	NA		1268
Selenium	0.92 - 1.2	4 / 8	(50%)	390		0.5
Silver	0.94 - 0.94	1 / 8	(13%)	390		0.6
Sodium	70.8 - 279	8 / 8	(100%)	NA		130
Thallium	1.3 - 2.4	7 / 8	(88%)	6.3		0.3
Vanadium	9.9 - 29.4	8 / 8	(100%)	550		25
Zinc	34 - 742	8 / 8	(100%)	23,000		95
Cyanide	0.23 - 4.8	4 / 8	(50%)	1,600		0.5

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Table A: Tier 1 Soil Remediation Objectives for Residential Properties. The lower of the Ingestion or Inhalation exposure route specific values was used. (2) Appendix A, Table G: Concentration of Inorganic Chemicals in Background Soils; and (3) Site-specific background concentrations for PAHs.

(3) Standard for cis-1,2-DCE used for 1,2-Dichloroethene

Table 2

S.E. Rockford Source Area Risk Assessment - Area 7 Surface Soil

Parameter	Surface Soil Area 7					
	Range of Detected Concentrations	Proportion of Samples With Detections		Residential Soil Objective (Lower of inhal/inges)	Soil Component of GW Ingestion Route Values	Background
Volatile Organics (ug/kg)						
Methylene Chloride	4 - ***33***	7 / 12	(58%)	13,000	20	
Acetone	8 - 62	6 / 12	(50%)	7,800,000	16,000	
1,1-Dichloroethane	8 - 8	1 / 12	(8%)	1,300,000	23,000	
1,2-Dichloroethene (total)	220 - 220	1 / 12	(8%)	780,000 (3)	400	
1,2-Dichloroethane	7 - 8	2 / 12	(17%)	400	20	
1,1,1-Trichloroethane	5 - 40	3 / 12	(25%)	1,200,000	2,000	
Trichloroethene	4 - 140	2 / 12	(17%)	1,200,000	2,000	
Tetrachloroethene	5 - ***400***	4 / 12	(33%)	11,000	60	
1,1,2,2-Tetrachloroethane	12 - 12	1 / 12	(8%)	NA	NA	
Toluene	1 - 7	4 / 12	(33%)	650,000	12,000	
Semivolatile Organics (ug/kg)						
Isophorone	150 - 150	1 / 12	(8%)	4,600,000	8,000	
Fluoranthene	42 - 42	1 / 12	(8%)	3,100,000	4,300,000	809
Pyrene	37 - 37	1 / 12	(8%)	2,300,000	4,200,000	670
bis(2-Ethylhexyl)Phthalate	46 - 570	12 / 12	(100%)	46,000	3,600,000	
Benzo (a) Pyrene	170 - ***170***	1 / 12	(8%)	90	8,000	389
Pesticides & PCBs (ug/kg)						
Dieldrin	5.3 - ***38***	3 / 12	(25%)	40	4	
4,4'-DDE	13 - 13	1 / 12	(8%)	2,000	54,000	
Endosulfan II	15 - 15	1 / 12	(8%)	470,000	18,000	
4,4'-DDT	5.8 - 35	3 / 12	(25%)	2,000	32,000	
Endrin aldehyde	5.1 - 33	4 / 12	(33%)	23,000 (4)	1,000	
gamma-Chlordane	20 - 20	1 / 12	(8%)	500	10,000	
Aroclor-1260	450 - 450	1 / 12	(8%)	1,000	NA	
Inorganics (mg/Kg)						
Aluminum	8,630 - 15,800	12 / 12	(100%)	NA		9,500
Antimony	9.4 - 12.7	7 / 12	(58%)	31		4
Arsenic	3.6 - ***6.8***	12 / 12	(100%)	0.4		7.2
Barium	41.6 - 260	12 / 12	(100%)	5,500		110
Beryllium	0.13 - ***0.66***	12 / 12	(100%)	0.1		0.59
Cadmium	1.6 - 1.6	1 / 12	(8%)	78		0.6
Calcium	929 - 27,100	12 / 12	(100%)	NA		9,300
Chromium	10.1 - 55.1	12 / 12	(100%)	270		16.2
Cobalt	5.2 - 11.3	12 / 12	(100%)	4,700		8.4
Copper	7.6 - 148	12 / 12	(100%)	2,900		19.6
Iron	10,600 - 19,200	12 / 12	(100%)	NA		15,900
Lead	9.7 - 217	12 / 12	(100%)	400		36
Magnesium	1,400 - 17,400	12 / 12	(100%)	NA		4,820
Manganese	292 - 698	12 / 12	(100%)	3,700		636
Mercury	0.06 - 2.2	3 / 12	(25%)	10		0.06
Nickel	7.3 - 49.1	12 / 12	(100%)	1,600		18
Potassium	800 - 1,550	12 / 12	(100%)	NA		1,268
Selenium	0.92 - 1.4	8 / 12	(67%)	390		0.48
Silver	1.4 - 1.4	1 / 12	(8%)	390		0.55
Sodium	26.7 - 178	12 / 12	(100%)	NA		130
Thallium	1.9 - 2.1	2 / 12	(17%)	6		0.32
Vanadium	19.2 - 36.4	12 / 12	(100%)	550		25.2
Zinc	31.3 - 177	12 / 12	(100%)	23,000		95
Cyanide	0.25 - 2.9	6 / 12	(50%)	1,600		0.51

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Table A: Tier 1 Soil Remediation Objectives for Residential Properties. The lower of the Ingestion or Inhalation exposure route specific values was used. (2) Appendix A, Table G: Concentration of Inorganic Chemicals in Background Soils; and (3) Site-specific background concentrations for PAHs.

(3) Standard for cis-1,2-DCE used for 1,2-Dichloroethene (total).

(4) Standard for endrin used for endrin aldehyde.

Table 3

S.E. Rockford Source Area Risk Assessment - Area 9/10 Surface Soil

Parameter	Surface Soils - Area 9/10					
	Range of Detected Concentrations	Proportion of Samples With Detections		Residential Soil Objective (Lower of inges/inhal)	Soil Component of GW Ingestion Route Values	Background
Volatile Organics (ug/Kg)						
Methylene Chloride	2 - 3	2 / 5	(40%)	13,000	20	
Toluene	11 - 11	1 / 5	(20%)	650,000	12,000	
Semivolatile Organics (ug/Kg)						
Naphthalene	320 - 320	1 / 4	(25%)	3,100,000	84,000	297
2-Methylnaphthalene	250 - 250	1 / 4	(25%)	NA	NA	297
Acenaphthene	200 - 350	2 / 4	(50%)	4,700,000	570,000	297
Dibenzofuran	190 - 190	1 / 4	(25%)	NA	NA	
Fluorene	190 - 340	2 / 4	(50%)	3,100,000	560,000	297
Phenanthrene	400 - 3,600	4 / 4	(100%)	NA	NA	446
Anthracene	55 - 640	4 / 4	(100%)	23,000,000	12,000,000	195
Carbazole	59 - 530	4 / 4	(100%)	32,000	600	
Di-n-Butylphthalate	1,200 - 1,600	2 / 4	(50%)	2,300,000	2,300,000	
Fluoranthene	650 - 4,800	4 / 4	(100%)	3,100,000	4,300,000	809
Pyrene	580 - 4,200	4 / 4	(100%)	2,300,000	4,200,000	670
Butylbenzylphthalate	60 - 660	2 / 4	(50%)	930,000	930,000	
Benzo(a)anthracene	330 - ***2,300***	4 / 4	(100%)	900	2,000	401
Chrysene	310 - 2,100	4 / 4	(100%)	88,000	160,000	431
bis(2-Ethylhexyl)Phthalate	130 - 7,400	4 / 4	(100%)	46,000	3,600,000	
Benzo (b) Fluoranthene	420 - ***2,800***	4 / 4	(100%)	900	5,000	539
Benzo (k) Fluoranthene	220 - 890	4 / 4	(100%)	900	49,000	301
Benzo (a) Pyrene	260 - ***1,700***	4 / 4	(100%)	90	8,000	389
Indeno (1,2,3-cd) Pyrene	230 - ***1,300***	4 / 4	(100%)	900	14,000	317
Benzo (g,h,i) Perylene	270 - 1,400	4 / 4	(100%)	NA	NA	329
Pesticides & PCBs (ug/Kg)						
Heptachlor epoxide	2.5 - 2.5	1 / 4	(25%)	70	700	
Dieldrin	4.1 - ***54***	2 / 4	(50%)	40	4	
4,4'-DDE	17 - 17	1 / 4	(25%)	2,000	54,000	
4,4'-DDD	7.1 - 7.1	1 / 4	(25%)	3,000	16,000	
4,4'-DDT	7 - 41	2 / 4	(50%)	2,000	32,000	
gamma-Chlordane	2 - 2	1 / 4	(25%)	500	10,000	
Aroclor-1254	30 - 30	1 / 4	(25%)	1,000	NA	
Inorganics (mg/Kg)						
Aluminum	2,550 - 8,860	6 / 6	(100%)	NA		9,500
Arsenic	2.8 - ***6.2***	6 / 6	(100%)	0.4		7.2
Barium	27 - 119	6 / 6	(100%)	5500		110
Beryllium	0.35 - ***0.7***	6 / 6	(100%)	0.1		0.59
Cadmium	0.43 - 1.2	5 / 6	(83%)	78		0.6
Calcium	2,590 - 131,000	6 / 6	(100%)	NA		9,300
Chromium	5.4 - 15.4	6 / 6	(100%)	270		16.2
Cobalt	2.8 - 6.2	6 / 6	(100%)	4700		8.9
Copper	7.8 - 148	6 / 6	(100%)	2900		19.6
Iron	7,390 - 13,600	6 / 6	(100%)	NA		15,900
Lead	15.1 - 112	6 / 6	(100%)	400		36
Magnesium	1530 - 83,700	6 / 6	(100%)	NA		4,820
Manganese	264 - 592	6 / 6	(100%)	3700		636
Nickel	6.8 - 13.8	6 / 6	(100%)	1600		18
Potassium	296 - 856	6 / 6	(100%)	NA		1,268
Sodium	70.8 - 279	6 / 6	(100%)	NA		130
Vanadium	9.9 - 26.1	6 / 6	(100%)	550		25.2
Zinc	34 - 742	6 / 6	(100%)	23000		95
Cyanide	0.23 - 0.46	3 / 6	(50%)	1600		0.51

NOTES:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Table A: Tier 1 Soil Remediation Objectives for Residential Properties. The lower of the Ingestion or Inhalation exposure route specific values

(2) Appendix A, Table G: Concentration of Inorganic Chemicals in Background Soils; and (3) Site-specific background concentrations for PAHs

(3) Standard for chlordane used for gamma chlordane.

Table 4

S.E. Rockford Source Area Risk Assessment - Area 11 Surface Soil

Parameter	Surface Soils - Area 11			
	Range of Detected Concentrations	Proportion of Samples With Detections	Residential Soil Objective (Lower of inges/inhal)	Soil Component of GW Ingestion Route Values	Background
Volatile Organics (ug/Kg)					
No Hits					
Semivolatile Organics (ug/Kg)					
Naphthalene	42 - 15,000	2 / 7 (29%)	3,100,000	84,000	297
2-Methylnaphthalene	45 - 45	1 / 7 (14%)	NA	NA	297
Acenaphthene	70 - 39,000	2 / 7 (29%)	4,700,000	570,000	297
Dibenzofuran	57 - 33,000	2 / 7 (29%)	NA	NA	
Fluorene	130 - 47,000	2 / 7 (29%)	3,100,000	560,000	297
Phenanthrene	54 - 370,000	7 / 7 (100%)	NA	NA	446
Anthracene	160 - 93,000	2 / 7 (29%)	23,000,000	12,000,000	195
Carbazole	65 - ***67,000***	2 / 7 (29%)	32,000	600	
Di-n-Butylphthalate	94 - 5,200	5 / 7 (71%)	2,300,000	2,300,000	
Fluoranthene	110 - 440,000	7 / 7 (100%)	3,100,000	4,300,000	809
Pyrene	57 - 430,000	4 / 7 (57%)	2,300,000	4,200,000	670
Butylbenzylphthalate	44 - 44	1 / 7 (14%)	930,000	930,000	
Benzo(a)anthracene	69 - ***200,000***	7 / 7 (100%)	900	2,000	401
Chrysene	52 - ***240,000***	7 / 7 (100%)	88,000	160,000	431
bis(2-Ethylhexyl)Phthalate	880 - 40,000	7 / 7 (100%)	46,000	3,600,000	
Di-n-Octyl Phthalate	66 - 100	2 / 7 (29%)	1,600,000	10,000,000	
Benzo (b) Fluoranthene	86 - ***220,000***	7 / 7 (100%)	900	5,000	539
Benzo (k) Fluoranthene	46 - ***130,000***	7 / 7 (100%)	900	49,000	301
Benzo (a) Pyrene	96 - ***150,000***	3 / 7 (43%)	90	8,000	389
Indeno (1,2,3-cd) Pyrene	63 - ***120,000***	3 / 7 (43%)	900	14,000	317
Dibenzo (a,h) Anthracene	70 - 70	1 / 7 (14%)	90	2,000	297
Benzo (g,h,i) Perylene	2,000 - 120,000	2 / 7 (29%)	NA	NA	329
Pesticides & PCBs (ug/Kg)					
delta-BHC	0.24 - 0.38	2 / 7 (29%)	NA	NA	
Heptachlor	13 - 13	1 / 7 (14%)	100	23,000	
Aldrin	0.69 - 2.3	2 / 7 (29%)	40	500	
Heptachlor epoxide	0.54 - 24	2 / 7 (29%)	70	700	
Endosulfan I	0.64 - 0.64	1 / 7 (14%)	470,000	18,000	
Dieldrin	0.11 - ***10***	6 / 7 (86%)	40	4	
4,4'-DDE	0.79 - 3.5	2 / 7 (29%)	2,000	54,000	
Endrin	0.68 - 1.2	2 / 7 (29%)	23,000	1,000	
Endosulfan II	0.36 - 3.2	2 / 7 (29%)	470,000	18,000	
4,4'-DDD	0.34 - 12	3 / 7 (43%)	3,000	16,000	
4,4'-DDT	0.94 - 0.94	1 / 7 (14%)	2,000	32,000	
Methoxychlor	4.6 - 30	5 / 7 (71%)	390,000	160,000	
Endrin ketone	1.1 - 11	2 / 7 (29%)	23,000	1,000	
Endrin aldehyde	0.47 - 9.7	3 / 7 (43%)	23,000	1,000	
alpha-Chlordane	0.35 - 120	6 / 7 (86%)	500	10,000	
gamma-Chlordane	3 - 180	2 / 7 (29%)	500	10,000	
Aroclor-1254	31 - 530	4 / 7 (57%)	1,000	NA	
Aroclor-1260	350 - 450	2 / 7 (29%)	1,000	NA	
Inorganics (mg/Kg)					
Aluminum	2,550 - 8,860	6 / 6 (100%)	NA		9,500
Antimony	0.52 - 0.55	2 / 7 (29%)	31		4.0
Arsenic	2.8 - ***6.2***	6 / 6 (100%)	0.4		7.2
Barium	27 - 119	6 / 6 (100%)	5,500		110
Beryllium	0.35 - ***0.7***	6 / 6 (100%)	0.1		0.59
Cadmium	0.43 - 1.2	5 / 6 (83%)	78		0.6
Calcium	2,590 - 131,000	6 / 6 (100%)	NA		9,300
Chromium	5.4 - 15.4	6 / 6 (100%)	270		16.2
Cobalt	2.8 - 6.2	6 / 6 (100%)	4,700		8.9
Copper	7.8 - 148	6 / 6 (100%)	2,900		19.6
Iron	7,390 - 13,600	6 / 6 (100%)	NA		15,900
Lead	15.1 - 112	6 / 6 (100%)	400		36
Magnesium	1,530 - 83,700	6 / 6 (100%)	NA		4,820
Manganese	264 - 592	6 / 6 (100%)	3,700		636
Mercury	0.06 - 0.06	2 / 7 (29%)	10		0.06
Nickel	6.8 - 13.8	6 / 6 (100%)	1,600		18
Potassium	296 - 856	6 / 6 (100%)	NA		1,268
Selenium	0.92 - 1.1	3 / 6 (50%)	390		0.48
Sodium	70.8 - 279	6 / 6 (100%)	NA		130
Thallium	1.3 - 2.4	6 / 6 (100%)	3		0.32
Vanadium	9.9 - 26.1	6 / 6 (100%)	550		25.2
Zinc	34 - 742	6 / 6 (100%)	23,000		95
Cyanide	0.23 - 0.48	3 / 6 (50%)	1,600		0.51

NOTES:

NA = Criterion not available.

(1) ***Bold Italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Table A: Tier 1 Soil Remediation Objectives for Residential Properties. The lower of the ingestion or inhalation exposure route specific values

(2) Appendix A, Table G: Concentration of Inorganic Chemicals in Background Soils; and (3) Site-specific background concentrations for PAHs.

(3) Standard for endosulfan used for endosulfan II.

(4) Standard for endrin used for endrin keytone and endrin aldehyde.

(5) Standard for chlordane used for alpha and gamma chlordane.

Table 5
S.E. Rockford Source Area Risk Assessment - Area 4 Subsurface Soil: Above 10 Feet

Parameter	Subsurface Soil - Area 4			
	Range of Detected Concentrations	Proportion of Samples With Detections	Residential Soil Objective (Lower of inhal/inges)	Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)	ND			
Semivolatile Organics (ug/Kg)	ND			
Pesticides & PCBs (ug/Kg)				
gamma-BHC (Lindane)	0.12 - 0.12	1 / 1 (100)%	NA	NA
Endosulfan II	0.22 - 0.22	1 / 1 (100)%	470,000	18,000
4,4'-DDD	0.24 - 0.24	1 / 1 (100)%	3,000	16,000

Notes:
NA = Criterion not available.
No exceedances.
(1) All samples collected above 10 feet.

Table 6

S.E. Rockford Source Area Risk Assessment - Area 7 Subsurface Soil: Above 10 Feet

Parameter	Subsurface Soil - Area 7				
	Range of Detected Concentrations	Proportion of Samples With Detections		Residential Soil Objective (Lower of inhal/inges)	Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)					
Methylene Chloride	6 - 6	1 / 4	(25)%	13,000	20
Acetone	10 - 8,400	3 / 4	(75)%	7,800,000	16,000
Carbon Disulfide	2 - 2	1 / 4	(25)%	720,000	32,000
1,1-Dichloroethene	3 - 3	1 / 4	(25)%	700,000	60
1,1-Dichloroethane	39 - 39	1 / 4	(25)%	1,300,000	23,000
1,2-Dichloroethene (total)	5 - ***49,000***	2 / 4	(50)%	780000 (3)	400
1,1,1-Trichloroethane	11 - ***360,000***	4 / 4	(100)%	1,200,000	2,000
Trichloroethene	3 - ***24,000***	4 / 4	(100)%	5,000	60
1,1,2-Trichloroethane	4 - 4	1 / 4	(25)%	310,000	20
Tetrachloroethene	29 - ***110,000***	4 / 4	(100)%	11,000	60
Toluene	1 - ***23,000***	3 / 4	(75)%	650,000	12,000
Ethylbenzene	2 - ***26,000***	3 / 4	(75)%	400,000	13,000
Styrene	1,600 - 1,600	1 / 4	(25)%	1,500,000	4,000
Xylene	11 - ***210,000***	3 / 4	(75)%	160,000,000	200,000
Semivolatile Organics (ug/Kg)					
Naphthalene	1,000 - 15,000	2 / 3	(67)%	3,100,000	84,000
2-Methylnaphthalene	1,100 - 10,000	2 / 3	(67)%	NA	NA
2,4-Dinitrotoluene	1,500 - ***1,500***	1 / 3	(33)%	900	0.8
Diethylphthalate	33 - 33	1 / 3	(33)%	2,000,000	470,000
Fluorene	130 - 130	1 / 3	(33)%	7,100,000	560,000
Phenanthrene	140 - 140	1 / 3	(33)%	NA	NA
Di-n-Butylphthalate	49 - 2,100	2 / 3	(67)%	2,300,000	2,300,000
bis(2-Ethylhexyl)Phthalate	110 - 1,200	2 / 3	(67)%	46,000	3,600,000
Pesticides & PCBs (ug/Kg)					
Heptachlor epoxide	3.3 - 3.3	1 / 3	(33)%	70	700
Aroclor-1254	480 - 480	1 / 3	(33)%	1,000	NA

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742 (1) Appendix B, Table A: Tier Soil Remediation Objectives for Residential Properties. The lower of the Ingestion or Inhalation exposure route specific values was used.

(3) Standard for cis-1,2-Dichloroethylene used for 1,2-Dichloroethene (total).

(4) All samples collected above 10 feet.

Table 7

S.E. Rockford Source Area Risk Assessment - Area 4 Subsurface Soil: Below 10 Feet

Parameter	Subsurface Soil - Area 4		
	Range of Detected Concentrations	Proportion of Samples With Detections	Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)			
Methylene Chloride	4 - 4	1 / 25 (4%)	20
Acetone	5 - 9	4 / 25 (16%)	16,000
1,1,1-Trichloroethane	2 - ***510,000***	7 / 25 (28%)	2,000
Benzene	2 - 2	1 / 25 (4%)	30
Tetrachloroethene	1 - 1	1 / 25 (4%)	60
Toluene	2 - 41	4 / 25 (16%)	12,000
Chlorobenzene	2 - 2	3 / 25 (12%)	1,000
Semivolatile Organics (ug/Kg)			
Naphthalene	470 - 3,000	2 / 8 (25%)	84,000
2-Methylnaphthalene	1,600 - 1,600	1 / 8 (13%)	NA
Phenanthrene	580 - 580	1 / 8 (13%)	NA
bis(2-Ethylhexyl)Phthalate	23 - 260	4 / 8 (50%)	3,600,000
Pesticides & PCBs (ug/Kg)			
alpha-BHC	2.8 - 4	2 / 8 (25%)	NA
beta-BHC	5.9 - 5.9	1 / 8 (13%)	NA
delta-BHC	1.8 - 1.8	1 / 8 (13%)	NA
gamma-BHC (Lindane)	0.14 - 1.6	2 / 8 (25%)	NA
Heptachlor	1.6 - 5.2	2 / 8 (25%)	23,000
Aldrin	2.3 - 2.3	1 / 8 (13%)	500
Endosulfan I	5.6 - 5.7	2 / 8 (25%)	18,000
4,4'-DDE	0.21 - 0.34	3 / 8 (38%)	54,000
Endosulfan II	0.17 - 0.44	4 / 8 (50%)	18,000
4,4'-DDT	0.59 - 0.59	1 / 8 (13%)	32,000
Methoxychlor	3.7 - 3.7	1 / 8 (13%)	160,000
Endrin aldehyde	0.78 - 1.5	2 / 8 (25%)	1,000

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed groundwater protection criterion. Chemicals will be further e in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Soil Remediation Objectives for Residential Properties.

Table 8

S.E. Rockford Source Area Risk Assessment - Area 7 Subsurface Soil: Below 10 Feet

Parameter	Subsurface Soil - Area 7			
	Range of Detected Concentrations	Proportion of Samples With Detections		Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)				
Methylene Chloride	12 - 12	1 / 52	2%	20
Acetone	8 - 140	13 / 52	25%	16,000
1,1-Dichloroethene	4 - 1,300	3 / 52	6%	60
1,1-Dichloroethane	2 - 2,900	13 / 52	25%	23,000
1,2-Dichloroethene (total)	1 - ***47,000***	29 / 52	56%	400
Chloroform	570 - ***570***	1 / 52	2%	0.6
1,2-Dichloroethane	2 - ***180***	4 / 52	8%	20
2-Butanone	13 - 1,500	2 / 52	4%	NA
1,1,1-Trichloroethane	1 - ***460,000***	36 / 52	69%	2,000
Trichloroethene	2 - ***130,000***	24 / 52	46%	60
1,1,2-Trichloroethane	460 - ***460***	1 / 52	2%	20
Benzene	220 - ***220***	1 / 52	2%	30
4-Methyl-2-Pentanone	3 - 82	4 / 52	8%	NA
Tetrachloroethene	1 - ***260,000***	34 / 52	65%	60
Toluene	1 - ***23,000***	29 / 52	56%	12,000
Chlorobenzene	1,600 - ***1,600***	1 / 52	2%	1,000
Ethylbenzene	1 - ***31,000***	18 / 52	35%	13,000
Styrene	0 - 0	0 / 52	0%	4,000
Xylene	2 - 190,000	23 / 52	44%	200,000
Semivolatile Organics (ug/Kg)				
4-Methylphenol	31 - 31	1 / 27	4%	NA
Isophorone	880 - 880	1 / 27	4%	8,000
Naphthalene	31 - 13,000	8 / 27	30%	84,000
2-Methylnaphthalene	35 - 7,300	6 / 27	22%	NA
2,4-Dinitrotoluene	0 - 0	0 / 27	0%	0.8
Diethylphthalate	21 - 1,800	12 / 27	44%	470,000
Fluorene	0 - 0	0 / 27	0%	560,000
Phenanthrene	35 - 43	2 / 27	7%	NA
Anthracene	43 - 43	1 / 27	4%	12,000,000
Di-n-Butylphthalate	28 - 1,700	22 / 27	81%	2,300,000
Fluoranthene	22 - 22	1 / 27	4%	4,300,000
Pyrene	24 - 24	1 / 27	4%	4,200,000
bis(2-Ethylhexyl)Phthalate	44 - 630	20 / 27	74%	3,600,000
Di-n-Octyl Phthalate	22 - 29	3 / 27	11%	1,000,000
Pesticides & PCBs (ug/Kg)				
alpha-BHC	0.28 - 0.28	1 / 27	4%	NA
gamma-BHC (Lindane)	0.68 - 0.68	1 / 27	4%	NA
Heptachlor	0.13 - 0.13	1 / 27	4%	23,000
Aldrin	15 - 15	1 / 27	4%	500
Heptachlor epoxide	2.8 - 2.8	1 / 27	4%	700
Dieldrin	2.1 - 2.1	1 / 27	4%	4
4,4'-DDE	0.35 - 12	2 / 27	7%	54,000
Endosulfan II	6.2 - 6.2	1 / 27	4%	18,000
4,4'-DDD	1 - 1	1 / 27	4%	16,000
Endosulfan sulfate	0.33 - 0.33	1 / 27	4%	18 (3)
4,4'-DDT	4 - 4	1 / 27	4%	32,000
Methoxychlor	4.4 - 33	2 / 27	7%	160,000
Endrin aldehyde	1.7 - 1.7	1 / 27	4%	1,000
alpha-Chlordane	9.8 - 9.8	1 / 27	4%	10,000
gamma-Chlordane	1.3 - 1.3	1 / 27	4%	10,000
Aroclor-1232	250 - 490	2 / 27	7%	NA
Aroclor-1242	21 - 170	4 / 27	15%	NA
Aroclor-1254	5.6 - 2,500	8 / 27	30%	NA
Aroclor-1260	58 - 58	1 / 27	4%	NA

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Ap Soil Remediation Objectives for Residential Properties.

(3) Standard for endosulfan used for endosulfan sulfate.

Table 9

S.E. Rockford Source Area Risk Assessment - Area 9/10 Subsurface Soil: Below 10 Feet

Parameter	Subsurface Soil - Area 9/10			
	Range of Detected Concentrations	Proportion of Samples With Dectections		Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)				
Methylene Chloride	3 - ***48***	21 / 89	(24%)	20
Acetone	2 - 11	14 / 89	(16%)	16,000
1,1-Dichloroethene	2 - 2	1 / 89	(1%)	60
1,2-Dichloroethene (total)	5 - 86	2 / 89	(2%)	400
2-Butanone	4 - 10	5 / 89	(6%)	NA
1,1,1-Trichloroethane	1 - 50	4 / 89	(4%)	2,000
Trichloroethene	1 - 2	4 / 89	(4%)	60
1,1,2-Trichloroethane	6 - 6	1 / 89	(1%)	20
Tetrachloroethene	2 - 46	7 / 89	(8%)	60
Toluene	1 - 18	16 / 89	(18%)	12,000
Xylene	4 - 4	1 / 89	(1%)	200,000
Semivolatile Organics (ug/Kg)				
Naphthalene	420 - 420	1 / 24	(4%)	84,000
2-Methylnaphthalene	300 - 300	1 / 24	(4%)	NA
Acenaphthene	220 - 220	1 / 24	(4%)	570,000
Dibenzofuran	150 - 150	1 / 24	(4%)	NA
Fluorene	120 - 120	1 / 24	(4%)	560,000
Phenanthrene	0 - 0	0 / 24	(0%)	NA
Anthracene	0 - 0	0 / 24	(0%)	12,000,000
Carbazole	0 - 0	0 / 24	(0%)	600
Di-n-Butylphthalate	0 - 0	0 / 24	(0%)	2,300,000
Fluoranthene	0 - 0	0 / 24	(0%)	4,300,000
Pyrene	0 - 0	0 / 24	(0%)	4,200,000
Butylbenzylphthalate	0 - 0	0 / 24	(0%)	930,000
Benzo(a)anthracene	0 - 0	0 / 24	(0%)	2,000
Chrysene	0 - 0	0 / 24	(0%)	160,000
bis(2-Ethylhexyl)Phthalate	44 - 6,900	5 / 24	(21%)	3,600,000
Benzo (b) Fluoranthene	0 - 0	0 / 24	(0%)	5,000
Benzo (k) Fluoranthene	0 - 0	0 / 24	(0%)	49,000
Benzo (a) Pyrene	0 - 0	0 / 24	(0%)	8,000
Ideno (1,2,3-cd) Pyrene	0 - 0	0 / 24	(0%)	14,000
Benzo (g,h,i) Perylene	0 - 0	0 / 24	(0%)	NA
Pesticides & PCBs (ug/Kg)				
gamma-BHC (Lindane)	2.3 - 2.3	1 / 24	(4%)	NA
Heptachlor epoxide	0 - 0	0 / 24	(0%)	700
Dieldrin	0 - 0	0 / 24	(0%)	4
4,4'-DDE	0 - 0	0 / 24	(0%)	54,000
Endrin	3.8 - 3.8	1 / 24	(4%)	1,000
4,4'-DDD	0 - 0	0 / 24	(0%)	16,000
4,4'-DDT	6.4 - 6.4	1 / 24	(4%)	32,000
gamma-Chlordane	0 - 0	0 / 24	(0%)	10,000
Aroclor-1254	0 - 0	0 / 24	(0%)	NA

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Tabl Soil Remediation Objectives for Residential Properties.

Table 10

S.E. Rockford Source Area Risk Assessment - Area 11 Subsurface Soil: Below 10 Feet

Parameter	Subsurface Soil - Area 11			
	Range of Detected Concentrations	Proportion of Samples With Detections		Soil Component of GW Ingestion Route Value
Volatile Organics (ug/Kg)				
Methylene Chloride	1 - ***2,900***	10 / 52	(19%)	20
Acetone	2 - 5,100	13 / 52	(25%)	16,000
Carbon Disulfide	1 - 3	4 / 52	(8%)	32,000
2-Butanone	4 - 4	1 / 52	(2%)	NA
1,1,1-Trichloroethane	2 - 4	3 / 52	(6%)	2,000
Trichloroethene	410 - ***410***	1 / 52	(2%)	60
Benzene	5 - ***1,500***	2 / 52	(4%)	30
Tetrachloroethene	1 - 46	3 / 52	(6%)	60
Toluene	1 - ***1,400,000***	16 / 52	(31%)	12,000
Ethylbenzene	2 - ***590,000***	9 / 52	(17%)	13,000
Xylene	1 - ***2,300,000***	16 / 52	(31%)	200,000
Semivolatile Organics (ug/Kg)				
2-Methylphenol	60 - ***580***	7 / 19	(37%)	15
4-Methylphenol	61 - 640	5 / 19	(26%)	NA
Isophorone	100 - 1,400	2 / 19	(11%)	8,000
2-Nitrophenol	1,100 - 1,100	1 / 19	(5%)	NA
bis(2-Chloroethoxy)Methane	230 - 230	1 / 19	(5%)	NA
Naphthalene	80 - 1,900	5 / 19	(26%)	84,000
2-Methylnaphthalene	52 - 140	5 / 19	(26%)	NA
Phenanthrene	16 - 47	3 / 19	(16%)	NA
Anthracene	45 - 45	1 / 19	(5%)	12,000,000
Di-n-Butylphthalate	510 - 510	1 / 19	(5%)	2,300,000
Fluoranthene	49 - 49	1 / 19	(5%)	4,300,000
Pyrene	63 - 63	1 / 19	(5%)	4,200,000
bis(2-Ethylhexyl)Phthalate	110 - 1,300	6 / 19	(32%)	3,600,000
Di-n-Octyl Phthalate	45 - 260	3 / 19	(16%)	10,000,000
Pesticides & PCBs (ug/Kg)				
alpha-BHC	0.23 - 0.96	3 / 19	(16%)	NA
gamma-BHC (Lindane)	0.18 - 0.18	1 / 19	(5%)	NA
Aldrin	0.29 - 0.29	1 / 19	(5%)	500
4,4'-DDE	0.26 - 0.68	3 / 19	(16%)	54,000
Endosulfan II	0.34 - 0.34	1 / 19	(5%)	18,000
4,4'-DDD	0.29 - 0.29	1 / 19	(5%)	16,000
4,4'-DDT	0.3 - 0.56	4 / 19	(21%)	32,000
Endrin aldehyde	0.49 - 0.49	1 / 19	(5%)	1,000 (3)
alpha-Chlordane	0.18 - 0.18	1 / 19	(5%)	10,000 (4)

Notes:

NA = Criterion not available.

(1) ***Bold italicized*** values exceed human health criterion or groundwater protection criterion. Chemicals will be further evaluated in Tier 1 Phase 2 or Tier 3.

(2) Values were compared to the Illinois Register, Title 35, Subtitle G, Chapter I, Subchapter f, Part 742. (1) Appendix B, Table A: Tier 1 Soil Remediation Objectives for Residential Properties.

(3) Standard for endrin used for endrin aldehyde.

(4) Standard for chlordane used for alpha chlordane.

ten feet were compared to the Tier 1 SCGV only. Chemicals that exceeded a value are shown in bold and italics.

Comparison of Inorganic Data to State-wide Background

Chemicals that exceeded either an ERSVs or SCGVs were compared to background concentrations. **Figures 3 through 6** present the background soil sample locations for the four areas of concern. The SCGVs for inorganics are given in units of mg/L and are intended for comparison to Toxic Contaminant Leachate Proceedure (TCLP) data. These data were not collected for inorganics at the SCOU. All inorganics chemical concentrations were compared to background concentrations. Maximum concentrations of detected inorganic chemicals were compared to background concentrations for inorganics derived from TACO Appendix A, Table G: Concentrations of Inorganic Chemicals in Background Soils. Concentrations for counties within metropolitan statistical areas were used.

Maximum concentrations of one inorganic, beryllium, was above the state-wide background concentrations identified in TACO. Therefore, concentrations of beryllium were then compared to site-specific background to see if the maximum concentration was significantly different from background levels found in the area.

Comparison of Inorganic Data to Site-Specific Background

Site-specific background samples were identified by Illinois EPA staff and consisted of twelve samples from areas 4, 7 and 9/10. Site-specific background data were used to evaluate beryllium which exceeded a TACO background concentration.

Illinois EPA used the Shapiro-Wilk test to evaluate the site-specific background data to determine which statistical methods would be appropriate for analyzing the data. Use of the Shapiro-Wilk test in this fashion is prescribed in 742.410(b) of the TACO regulations. The results of the Shapiro-Wilk test indicated that both the on-site beryllium data and the site-specific background data for beryllium were logonormally distributed. Because the beryllium site-specific background data set was logonormally distributed and contained greater than 10 samples with less than 15% non-detects, the TACO regulations suggest calculating an Upper Tolerance Limit (UTL) for the data. In consideration of the site-specific background data, UTL values provide a higher level of confidence that the newly calculated background value is representative of the site. UTL values were calculated for the log transformed site-specific background data for beryllium. The on-site beryllium data were then compared to the UTL values established for the site-specific background data set. None of the site data exceeded the UTL for beryllium which means that beryllium is not found at the site at levels considered to be above background.

Comparison of Organic Data to Site-Specific Background

The same background data set used for metals was used to evaluate SVOCs. A 95% Upper Confidence Limit (UCL) was calculated for concentrations of organic compounds detected within the site-specific background data set. Similar to the

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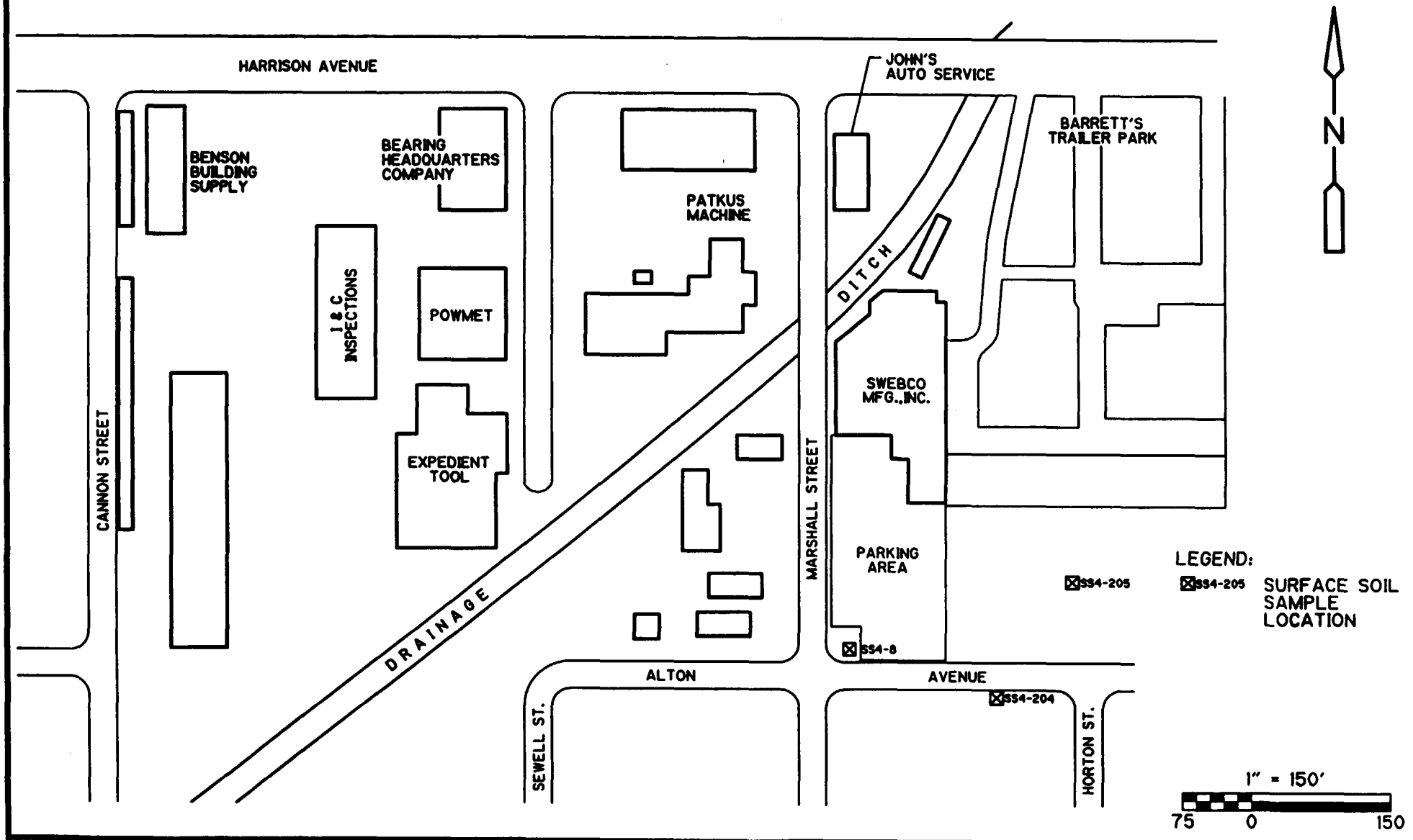

SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT

AREA 4 BACKGROUND SOIL SAMPLE LOCATIONS FOR PNA AND INORGANIC ANALYTES

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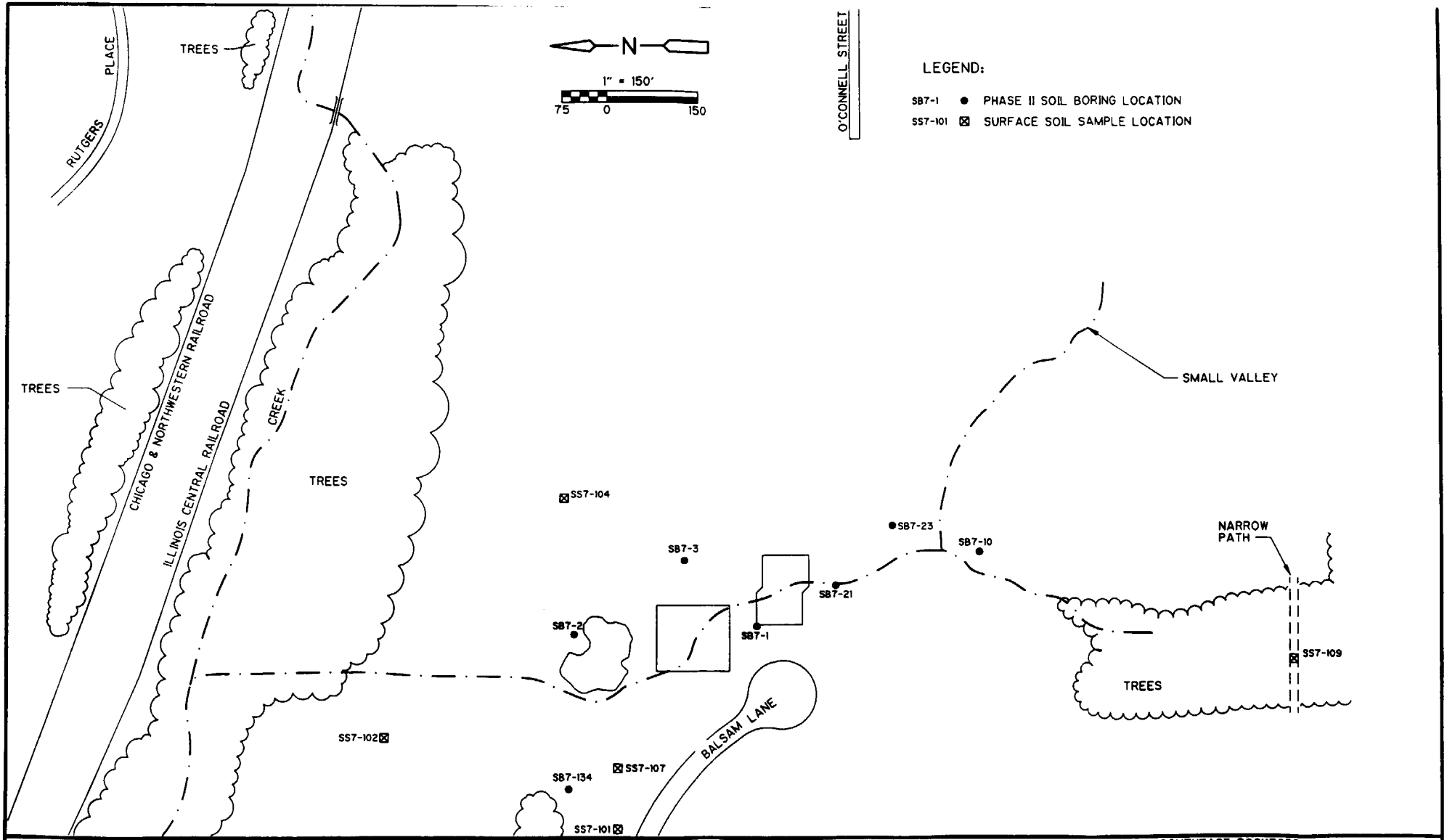
Figure No. 3



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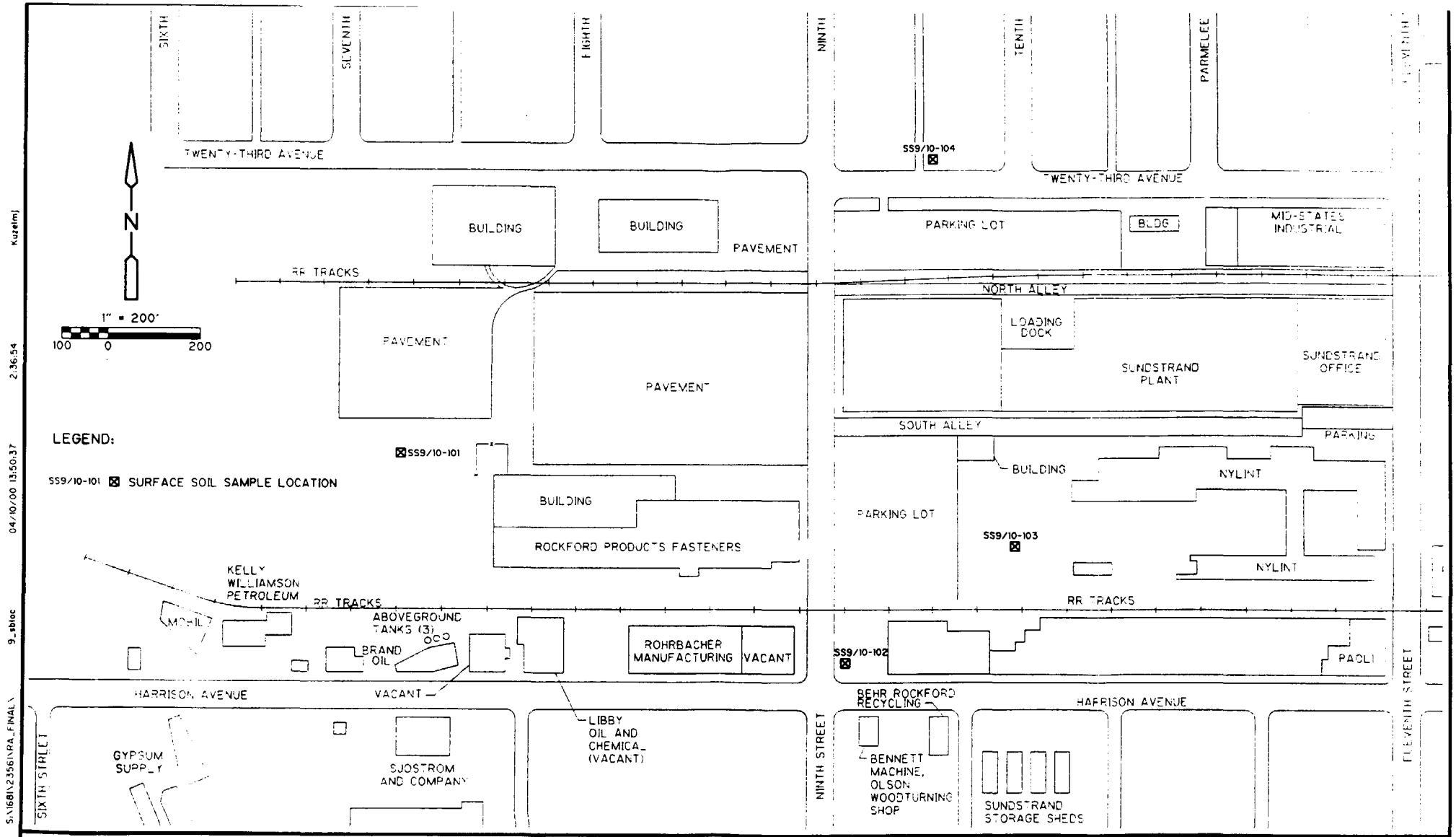
AREA 7 BACKGROUND SOIL SAMPLE LOCATIONS FOR PNA AND INORGANIC ANALYTES

Figure No. 4



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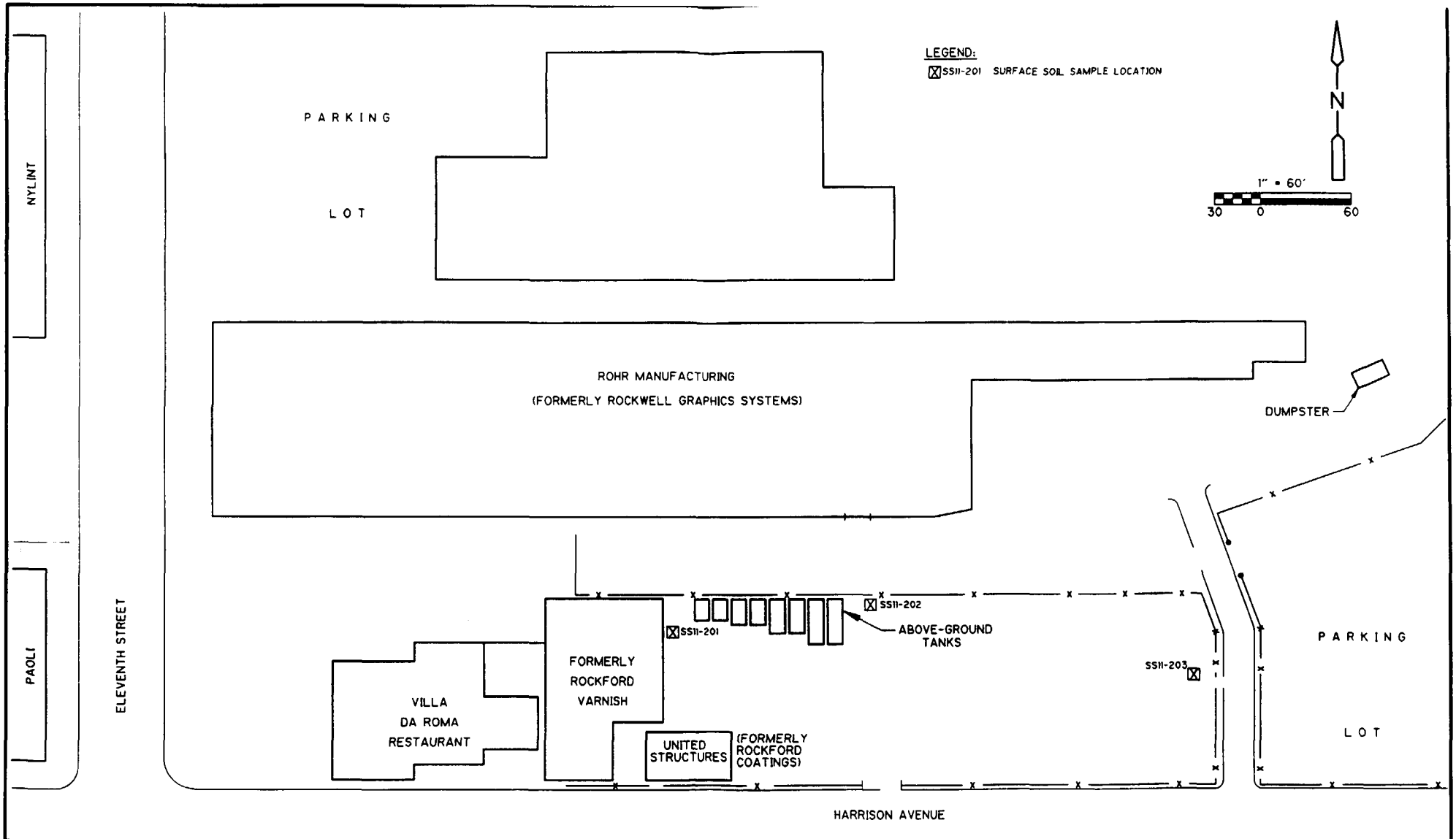
SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT

AREA 9/10 BACKGROUND SOIL SAMPLE LOCATIONS FOR PNA AND INORGANIC ANALYTES

Figure No. 5



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SOUTHEAST ROCKFORD SOURCE CONTROL OPERABLE UNIT

AREA 11 BACKGROUND SOIL SAMPLE LOCATIONS FOR PNA AND INORGANIC ANALYTES

Figure No. 6

Upper Tolerance Limit, calculating a UCL for the site-specific background data provides values with a higher level of confidence that the newly calculated background value is representative of the site. The maximum concentrations detected at the site were then compared to the UCL background values. Table 11 presents this comparison. The UCL background values are also included in Tables 1-4 for comparison purposes. Table 12 summarizes the comparisons made in tables 1-4. Maximum concentrations of SVOCs in Area 7 were below calculated UCL background concentrations and were therefore dropped from consideration as contaminants of concern in this area. SVOCs in Areas 4, 9/10, and 11 exceeded background and therefore could not be dropped from further evaluation. Maximum concentrations of SVOCs in Area 7 were below calculated UCL background concentrations and were dropped from futher evaluation. Maximum concentrations of two SVOCs in area 11, 2-methynaphthalene and dibenzo (a,h) anthracene, were below background concentrations. 2-Methylnaphthalene was below background in area 9/10 and naphthalene, 2- methylnaphthalene and benzo (g,h,i) perylene were below background in area 4. These SVOCs were dropped from further evaluation. All other SVOCs exceeded background, and therefore could not be dropped from further evaluation.

Tables 12 through 14 summarize the results of comparisons made in Tables 1-10 as well as the four exclusion criteria described below. Chemicals that were not excluded by these criteria for the direct contact pathway were carried into the Tier 1 -Phase 2 analysis. Chemicals that were not excluded by these criteria for the protection of groundwater were carried into tier 3 analysis.

Exclusion Criteria
1. Maximum concentrations below TACO or site-specific background.
2. Inorganics detected at concentrations found not to be significantly different than site-specific background concentrations.
3. For the soil to groundwater route only - chemicals detected at low frequency of detection in soil or not detected in groundwater; and
4. Maximum concentrations below the PQL.

In summary, in the Tier 1-Phase 1 analysis, site concentrations for each chemical were compared to TACO Tier ERSVs (direct contact) and SCGVs (protection of groundwater). This comparison is shown within Tables 1 through 10. As described previously, chemicals that exceeded a TACO Tier 1 value were excluded from further evaluation using the four exclusion criteria.

Table 11

Comparison of Maximum Concentrations of Site Data with Background Data for SVOCs

Southeast Rockford - Source Control Operable Unit Risk Assessment

Analytes	Background (ug/kg)	Area 11 (ug/kg)	Area 9/10 (ug/kg)	Area 7 (ug/kg)	Area 4 (ug/kg)
Naphthalene	296.5	***15,000***	***320***	-	260
2-Methylnaphthalene	296.5	45	250	-	120
Acenaphthene	296.5	***39,000***	***350***	-	***960***
Fluorene	296.5	***47,000***	***340***	-	***920***
Phenanthrene	446.4	***370,000***	***3,600***	-	***16,000***
Anthracene	194.5	***93,000***	***640***	-	***1,000***
Fluoranthene	808.8	***440,000***	***4,800***	42	***12,000***
Pyrene	670.0	***430,000***	***4,200***	37	***5,000***
Benzo(a)anthracene	401.1	***200,000***	***2,300***	-	***5,600***
Chrysene	431.2	***240,000***	***2,100***	-	***5,900***
Benzo (b) Fluoranthene	538.8	***220,000***	***2,800***	-	***11,000***
Benzo (k) Fluoranthene	301.2	***130,000***	***890***	-	***11,000***
Benzo (a) Pyrene	389.0	***150,000***	***1,700***	170	***1,100***
Indeno (1,2,3-cd) Pyrene	316.7	***120,000***	***1,300***	-	***620***
Dibenzo (a,h) Anthracene	296.5	70	-	-	***430***
Benzo (g,h,i) Perylene	329.3	***120,000***	***1,400***	-	70

Notes:

Bold and Italicized concentrations exceed background levels.

Table 12

Tier 1 Exceedances and Selection of Chemicals of Concern for Surface Soil

Southeast Rockford - Source Control Operable Unit Risk Assessment

AREA	Exceedance			Selected Chemicals of Concern		Reason for Exclusion	
	Direct Contact	Soil to GW	Background	Direct Contact	Soil to GW	Direct Contact	Soil to GW
Area 4 (Residential)							
Carbazole		X			no		Not GW Contaminant
Benzo (a) anthracene	X	X	X	yes	no		Not GW Contaminant
Benzo (b) Fluoranthene	X	X	X	yes	no		Not GW Contaminant
Benzo (k) Fluoranthene	X		X	yes			
Benzo (a) Pyrene	X		X	yes			
Dibenzo (a,h) Anthracene	X		X	no		Below PQL	
Arsenic	X			no		Below Background	
Beryllium	X			no		Below Background	
Area 7 (Residential)							
Methylene Chloride		X			yes		
Tetrachloroethene		X			yes		
Benzo (a) Pyrene	X			no		Below Background and PQL	
Dieldrin		X			no		Not GW Contaminant
Arsenic	X			no		Below Background	
Beryllium	X			no		Below Background	
Area 9/10 (Residential)							
Benzo (a) anthracene	X	X		yes	no		Not GW Contaminant
Benzo (a) Pyrene	X			yes			
Benzo (b) Fluoranthene	X			yes			
Indeno (1,2,3,-cd) Pyrene	X			yes			
Dieldrin	X	X		yes	no		Not GW Contaminant
Arsenic	X			no		Below Background	
Beryllium	X			no		Below Background	
Area 11 (Residential)							
Carbazole	X	X		yes	no		Not GW Contaminant
Benzo (a) anthracene	X	X		yes	no		Not GW Contaminant
Chrysene	X	X		yes	no		Not GW Contaminant
Benzo (b) Fluoranthene	X	X		yes	no		Not GW Contaminant
Benzo (k) Fluoranthene	X	X		yes	no		Not GW Contaminant
Benzo (a) Pyrene	X	X		yes	no		Not GW Contaminant
Indeno (1,2,3-cd) Pyrene	X	X		yes	no		Not GW Contaminant
Dieldrin		X			no		Not GW Contaminant
Arsenic	X			no		Below Background	
Beryllium	X			no		Below Background	

Table 13
Tier 1 Exceedances and Selection of Chemicals of Concern for Subsurface Soil: Above 10 Feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

AREA	Exceedance		Selected Chemicals of Concern		Reason for Exclusion	
	Direct Contact	Soil to GW	Direct Contact	Soil to GW	Direct Contact	Soil to GW
Area 7 (Residential)						
1,2-Dichloroethene		X		yes		
1,1,1-Trichloroethane		X		yes		
Trichloroethene		X		yes		
Tetrachloroethene		X		yes		
Toluene		X		yes		
Ethylbenzene		X		yes		
Xylene		X		yes		
2,4-Dinitrotoluene	X	X	no	no	(1)	(1)

Notes:
(1) More data needed to verify whether chemical of concern. To be addressed in Feasibility Study.

Table 14

Tier 1 Exceedances and Selection of Chemicals of Concern for Subsurface Soil: Below 10 Feet

Southeast Rockford - Source Control Operable Unit Risk Assessment

AREA	Exceedance		Selected Chemicals of Concern		Reason for Exclusion	
	Direct Contact	Soil to GW	Direct Contact	Soil to GW	Direct Contact	Soil to GW
Area 4 (Residential)						
1,1,1 - Trichloroethane		X		yes		
Area 7 (Residential)						
1,2-Dichloroethene (total)		X		yes		
Chloroform		X		no		(1)
1,2-Dichloroethane		X		yes		
1,1,1-Trichloroethane		X		yes		
Trichloroethene		X		yes		
Benzene		X		no		(1)
Tetrachloroethene		X		yes		
Toluene		X		yes		
Chlorobenzene		X		no		(1)
Ethylbenzene		X		yes		
Area 9/10 (Residential)						
Methylene Chloride		X		yes		
Area 11 (Residential)						
Methylene Chloride		X		yes		
Trichloroethene		X		yes		
Benzene		X		yes		
Toluene		X		yes		
Ethylbenzene		X		yes		
Xylene		X		yes		
2-Methylphenol		X		yes		

Notes:

(1) Frequency of detection <5%, not detected in groundwater.

3.2 Tier 1 -Phase 2

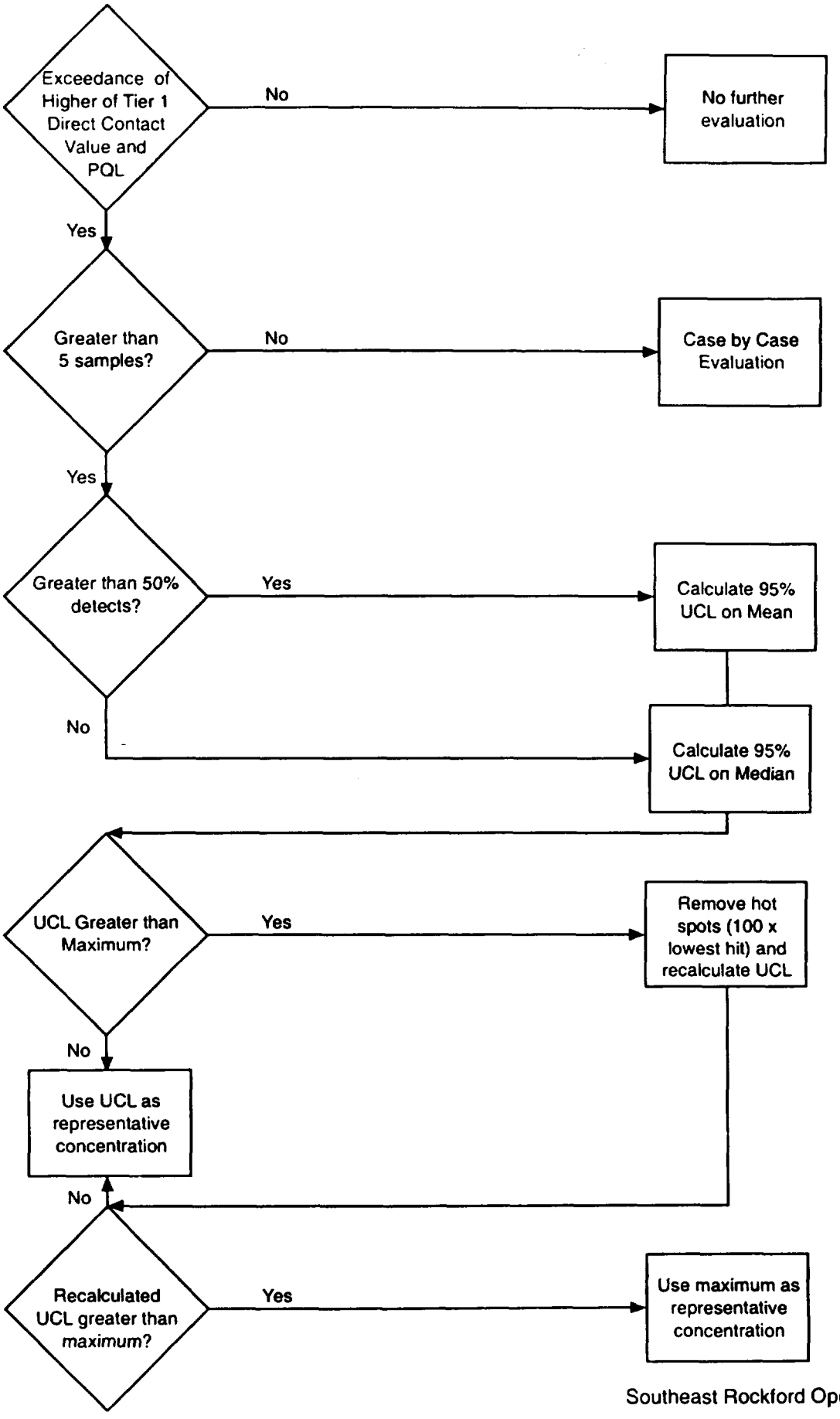
For chemicals that exceeded an ERSV and background concentrations (if available), the second phase of evaluation for the direct contact pathway involved the following steps

1. Calculate the 95% upper confidence limits (UCL) on the mean concentrations for chemicals that exceeded site-specific background and PQL.

2. Compare 95% UCLs to the higher of the Tier 1 concentrations or the practical quantitation limit (PQL) reported in SW-846 (Test Methods for Evaluating Solid Waste, Final Update, USEPA, December 1996).

Calculating 95% UCLs for those chemicals that exceeded an ERSV and background concentrations (if available) results in concentrations which are typically less conservative than maximum concentrations and more representative of an exposure point concentration than those used in Tier 1 -Phase 1. A procedure was developed for calculating the 95% UCL to accommodate conditions encountered among the datasets for the four different areas. Many of the detected concentrations were estimated values below the detection limits, ("J" values). This resulted in a large range of detected concentrations in areas that also had hot spots. For the purpose of the risk assessment, the term "hot spot" is defined as a specific location within one of the four areas of concern that contains concentrations which are two orders of magnitude above the lowest detected concentration within that area. In these areas, the value deviation for the data were large and resulted in 95% UCL values which exceeded maximum concentrations. For these areas, hot spots were removed from the data sets and UCLs were recalculated. Hot spots were later addressed in the feasibility study as areas of concern. Figure 7 presents the procedure for calculating 95% UCLs for PAHs.

A minimum of 5 samples were needed to calculate the 95% UCL. Chemicals with fewer than 5 samples were evaluated on a case by case basis. A minimum of 50% detections was needed to calculate the 95% UCL on the mean. If there were less than 50% detections, the 95% UCL on the median was calculated, as approved by Illinois EPA. In the event that a calculated, or recalculated (after removing hot spots) UCL exceeded a maximum concentration, the maximum concentration was used as the representative concentration for comparison to the higher of the Tier 1 value or the PQL. Table 15 presents the results of the 95% UCL evaluation. In areas 4 and 11, hot spots, where concentrations were two orders of magnitude greater than the lowest detected concentrations, were identified. These samples were removed from the data set and the 95% UCL was re-calculated. Hot spots were later addressed in the feasibility study for each of the four areas of concern. Following the removal of hot spots from the data sets, all remaining re-calculated concentrations were below the Tier 1 value or the PQL. In area 9, only four SVOC samples were available, not enough to calculate a 95% UCL. SVOCs in three of the four samples exceeded the



Southeast Rockford Operable Unit

Figure 7
Procedure for Calculating 95% Upper Confidence Limits for SVOCs

Table 15
Results of the Tier 1 (Phase 2) 95% UCL Calculations for SVOCs
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 4	
Surface	3 hot spot samples (SS4-201, SS4-203, SS4-203D) addressed in FS All other hits below PQL or Tier 1 values
Subsurface (<10 ft)	No SVOC exceedances(1)
Subsurface (>10 ft)	No SVOC exceedances(1)
Area 7	
Surface	No SVOC exceedances(1)
Subsurface (<10 ft)	No SVOC exceedances(1)
Subsurface (>10 ft)	No SVOC exceedances(1)
Area 9/10	
Surface	3 out of 4 samples with exceedances (SS910-101, SS910-103, SS910-104) addressed in FS
Subsurface (<10 ft)	No samples
Subsurface (>10 ft)	No SVOC exceedances(1)
Area 11	
Surface	2 hot spots (SS11-206, SS11-207) addressed in FS
Subsurface (<10 ft)	No samples
Subsurface (>10 ft)	No SVOC exceedances(1)

(1) maximum concentrations of SVOCs did not exceed Tier 1 values and/or background concentrations, therefore, 95%UCLs not calculated.

higher of the Tier 1 value and the PQL. This information was used in the feasibility study to determine the need for further sampling or remediation.

3.3 Results of Tier 1 Assessment

The results of the assessment of the direct contact pathway can be summarized as follows:

1. Maximum concentrations of all VOCs were below their respective ERSVs and were dropped from further evaluation for the direct contact pathway.

2. Maximum concentrations of SVOC and inorganics exceeded their respective ERSV sin all four areas.

3. Maximum concentrations of inorganics and one SVOC in area 7, benzo (a) pyrene, were dropped from further evaluation because detected concentrations were less than or consistent with background concentrations. Risk associated with these chemicals are below 1E-06 (one in one million) and/or a hazard index of 1.0.

4. Selected samples in Areas 4 (SS4-201, SS4-203, SS4-203D)and 11 (SS11-206, SS11-207) were identified as hot spots that exceeded Tier 1 values and PQLs for SVOCs. Three out of four samples in Area 9/10 (SS910-101, SS910-103, SS910-104) exceeded one or more PNA values. These data are presented in Appendix B. The hot spots in Areas 4 and 11 and the samples exceeding a PNA value in Area 9/10 will be addressed in the Feasibility Study. Additional data may be needed in the remedial design phase to better characterize risk and the extent of contamination. Based on the results of sampling, if necessary, remedial alternatives that address SVOCs would be developed and evaluated. The presence of these hot spots represents a potential exceedance of risk limits established by USEPA (a noncancer hazard index of 1.0 and cancer risks of between one in one million and one in one hundred thousand) and Illinois EPA (a noncancer index of 1.0 and cancer risks of one in one million used to develop the Tier 1 values) depending on actual exposure.

The results of the assessment of the soil to groundwater pathway can be summarized as follows:

1. Several chemicals were dropped from further evaluation for the soil to groundwater pathway because they were not detected in groundwater (Dieldrin, carbazole and several SVCOs).
2. VOCs in surface soil in area 4 and VOCs in subsurface soil in all four areas exceeded Tier 1 SCGV values. These VOCs were further evaluated in Tier 3.

Section 4
Tier 3 Assessment

A Tier 3 assessment was conducted for two pathways: (1) the soil component of the groundwater exposure route; and (2) ingestion of plants as part of an agricultural scenario.

4.1 Soil Component of the Groundwater Ingestion Pathway

A Tier 3 assessment was conducted for those chemicals that exceeded a SCGV and were detected in groundwater during past sampling events at greater than 5 percent frequency of detection. The Tier 3 assessment consisted of calculating soil concentration protective of groundwater at a designated point of compliance. The point of compliance is the boundary of the groundwater management zone (GMZ) established in each of the four areas. The GMZ is the area within which active remediation is underway.

Figure 2 presents the Tier 2 assessment process for the soil to groundwater pathway. TACO presents two models for calculating site-specific remediation objectives for the soil to groundwater pathway - the Soil Screening Level (SSL) Model and the Risk-Based Corrective Action (RBCA) Model. Only the RBCA model incorporates a component to address the dilution and attenuation that occurs in a GMZ, therefore, this was the model employed to calculate the Tier 3 concentrations.

The RBCA model incorporates site-specific information on the following variables:

- fraction of organic carbon (FOC)
- infiltration rate of water through soil
- hydraulic gradient
- hydraulic conductivity
- width of the source areas parallel to groundwater flow
- width of the source areas perpendicular to groundwater flow in the horizontal and vertical planes
- groundwater mixing zone thickness
- distance to boundary of groundwater management zone

The values used for these variables, as well as other default values used in the RBCA model, are presented in Appendix A. Equations R12 through R26, presented in Appendix C, Table C of TACO were used to calculate the Tier 3 concentrations. All of the variables used in these equations are defined in Table A-1 in Appendix A. Other key variables, including leaching factors, diffusion coefficients, saturation concentrations, and attenuation factors, are calculated and presented on Tables A-2 through A-5. The Tier 3 risk-based soil levels protective of groundwater are presented on **Table 16** for the chemicals of concern. Tier 1 concentrations are also presented for comparative purposes. Except for one chemical (trichloroethene) in Area 11, all Tier 3 concentrations were greater than the Tier 1 concentrations. The saturation concentrations are also presented, and, according to TACO, the ultimate remediation objective is the lower of the calculated concentration and the saturation concentration. The saturation concentration is the lower of the two concentrations for several chemicals in Areas 7, 9/10 and 11. Two hot spots, or source areas were identified in Area 7 and three hot spots were identified in Area 9 /10, each at different distances from the edge of the groundwater management zone (GMZ) and with different source widths and source thicknesses. **Figures 8 and 9** show the locations of the hot spots. The model used to calculate the SROs incorporates distance to the GMZ, source widths and thickness resulting in different degrees of attenuation between the source and an exposure point. For this reason, different SROs were calculated for each hot spot area associated with different degrees of attenuation (e.g. RBSLatten area 9/10c, RBSLatten area 9/10w). Areas 4 and 11 had only one hot spot. For this reason, only one set of remediation objectives was developed for areas 4 and 11. Tier 3 remediation objectives (or soil saturation concentrations, if lower) are compared to maximum detected concentrations. Per Taco 742.305(b), "no organic contaminant of concern may remain in the soil at concentrations which exceed the soil saturation limit". In Area 4, 1,1,1-TCA, the only chemical of concern, exceeds the SRO. In Area 7, cis-1,2-dichloroethene, tetrachloroethane, 1,1,1-trichloroethane, and trichloroethene exceed their respective SROs. In Area 11, benzene, ethyl- benzene, and trichloroethane exceed their respective SROs and toluene and xylene exceed their respective soil saturation concentrations.

Table 16
Risk-Based Soil Levels Protectiove of Groundwater for Each Area
Southeast Rockford Operable Unit

Comparison of Calculated Tier 3 Soil Remediation Objectives to Tier I (mg/kg)

Area 4	$RBSLatten_{area4}$	C^s_{sat}	Residential Class I GW Tier I SRO	Maximum Detected Concentration
1,1,1-Trichloroethane	9.118	1084	2	510

Area 7	$RBSLatten_{area7p}$	$RBSLatten_{area7d}$	C^s_{sat}	Residential Class I GW Tier I SRO	Maximum Detected Concentration
1,2-Dichloroethane	3.678	1787.000	1768	0.02	0.18
cis-1,2-Dichloroethene	0.941	11.500	1141	0.4	49
2,4-Dinitrotoluene	0.162	80.900	182	0.0008	1.5
Ethylbenzene	57.347	953.000	389	13	31
Methylene Chloride	1.15E+06	2.27E+12	2303	0.02	0.012
Tetrachloroethene	1.465	136	218	0.06	260
Toluene	337502367.730	3.74E+14	638	12	23
1,1,1-Trichloroethane	108.033	19622.000	1084	2	460
1,1,2-Trichloroethane	0.619	56.300	1784	0.02	0.46
Trichloroethene	0.310	7.200	1242	0.06	130
Xylenes (total)	34105.533	1.66E+07	312	150	210

Area 9/10	$RBSLatten_{area9/10c}$	$RBSLatten_{area9/10w}$	$RBSLatten_{area9/10no}$	C^s_{sat}	Residential Class I GW Tier I SRO	Maximum Detected Concentration
Methylene Chloride	3.26E+23	2.22E+12	4.13E+21	2303	0.02	0.048

Area 11	$RBSLatten_{area11}$	C^s_{sat}	Residential Class I GW Tier I SRO	Maximum Detected Concentration
Benzene	0.189	824	0.03	1.5
Ethylbenzene	7.983	389	13	590
Methylene Chloride	4.79E+07	2303	0.02	2.9
2-Methylphenol	2.82E+23	16827	15	0.58
Toluene	1.06E+10	638	12	1400
Trichloroethene	0.051	1242	0.06	0.41
Xylenes (total)	24500.418	312	150	2,300

Notes:
RBSLatten refers to the degree of attenuation associated with a particular source area as calculated using the equation R15 of TACO
C^s is the saturation concentration calculated using the equation S29 of TACO
SRO is the TACO Tier 1 soil remediation objective
The ultimate soil remediation objective for the protection of gorundwater is the lower of the RBSLatten concentration and the C^ssat value.
The exceptions are for ethylbenzene, trichloroethene, and total xylenes in Area 11, where the Residential Class 1 groundwater Tier 1 SRO is used instead

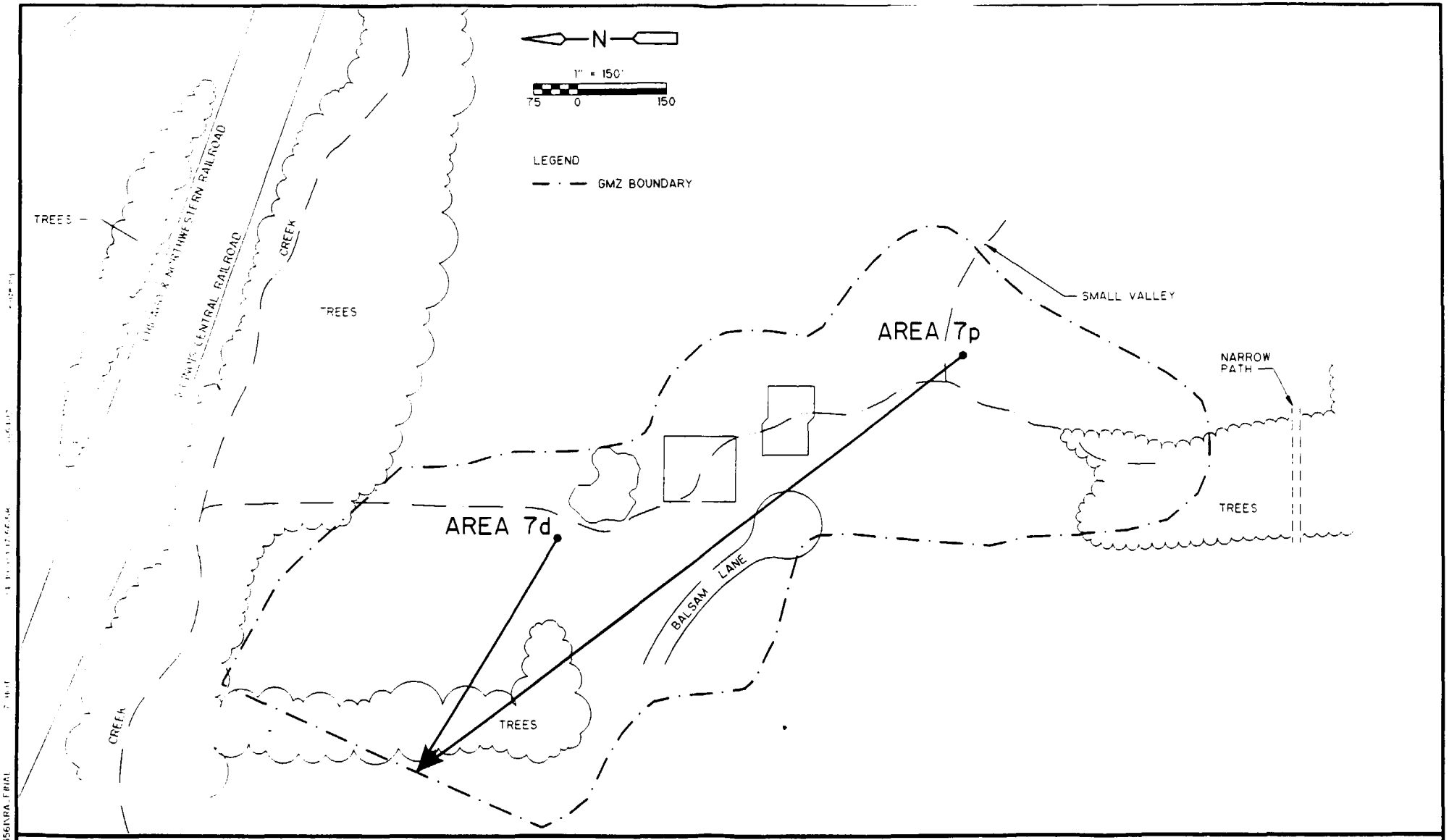


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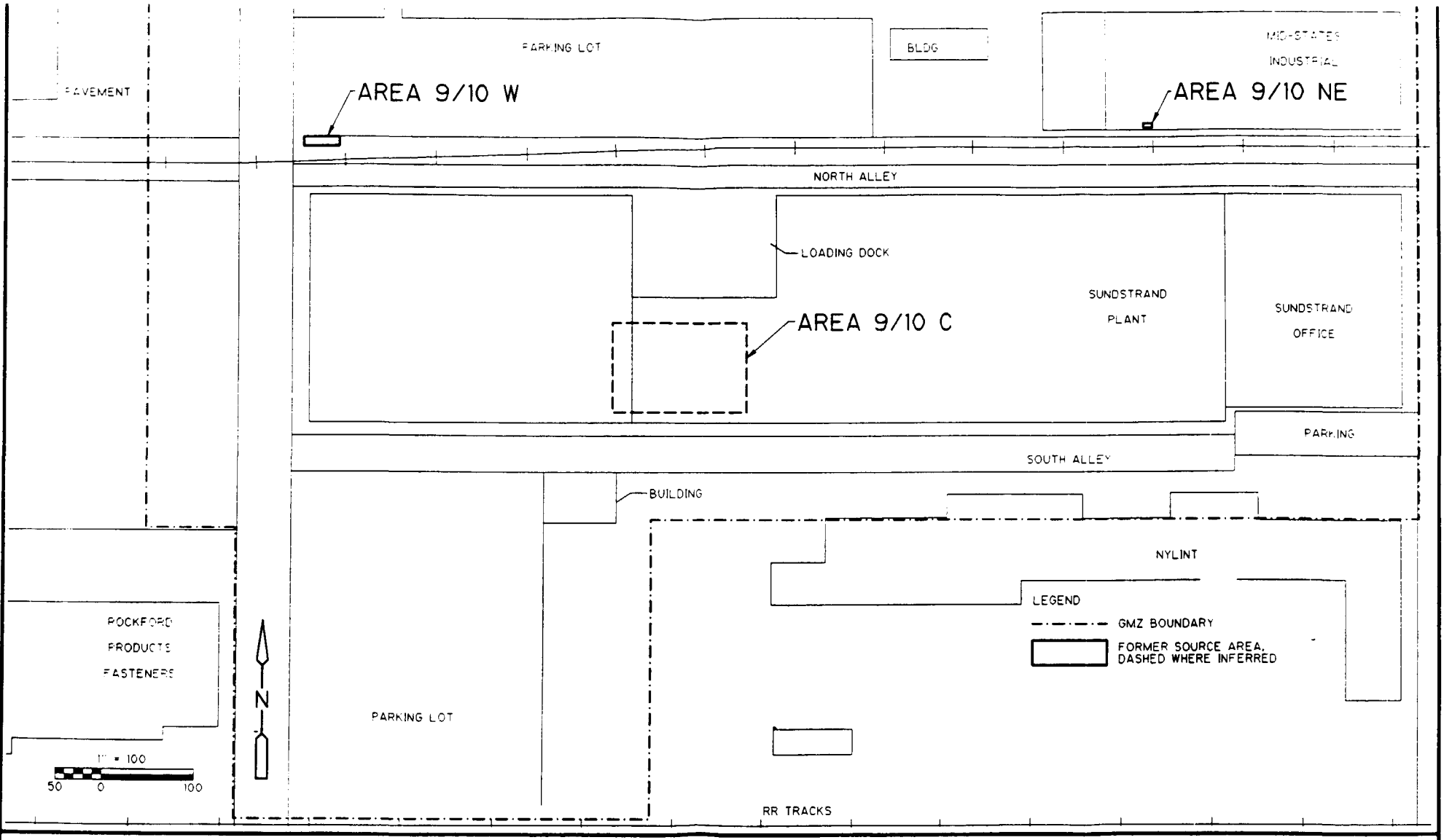
FIGURE No. 8
SOUTHEAST ROCKFORD
SOURCE CONTROL OPERABLE UNIT

HOTS SPOTS IN AREA 7



CDM
environmental engineers, scientists, planners, & management consultants

FIGURE No 9
SOUTHEAST ROCKFORD
SOURCE CONTROL OPERABLE UNIT

HOT SPOTS IN AREA 9 / 10

4.2 Vegetable Ingestion Pathway

Area 7 borders land currently used for agricultural purposes, and no current zoning restrictions prevent conversion of some of the undeveloped portions of Area 7 to agricultural use. For these reasons, a semi-quantitative evaluation was conducted to determine whether the use of Area 7 for growing vegetables or fruits would result in an unacceptable risk to human health. The use of this land for dairy farming was not considered due to the limited size of Area 7.

The qualitative evaluation of the potential agricultural pathway had the following steps:

1. Calculate a potential concentration in plants grown in Area 7 using soil-to-plant stem concentration factors;

2. Identify conservative plant ingestion rates and compare these rates to soil ingestion rates.

3. If ingestion rates are similar, compare plant concentrations to Tier 1 risk-based soil concentrations to determine whether risks are unacceptable.

Soil to plant stem concentrations factors are presented in Risk Assessment Handbook for the Massachusetts Military Reservation (Air National Guard, 1994). An estimated concentration in plants is obtained by multiplying the soil-to-plant concentration by the observed soil concentration as follows:

PC = (SCFsoil) (mean soil concentrations)

where

PC = concentration in plant

SCFsoil = soil-to-plant stem concentration factor

(mg contaminant per gram dry plant/mg contaminant per gram dry soil)

Table 17 presents average soil concentrations, SCFs and estimated plant concentrations for chemicals of concern identified in Area 7.

Plant ingestion rates were obtained from Soil Screening Guidance: Technical Background Document (EPA, 1996). Estimated homegrown fresh weight consumption rates for above ground unprotected vegetables and below ground unprotected vegetables were given as 76 mg/day and 28 mg/day, respectively. To compare to the unitized soil ingestion rate of 114 (milligrams per year for each kilogram of bodyweight per day) used to develop the Tier 1 soil values which is based

Table 17

Comparison of Average Soil Concentrations, SCFs and Estimated Plant Concentrations for COCs

Southeast Rockford Operable Unit

Parameter	Range of Detected Concentrations in soil	Proportion of Samples With Detections		Average Soil Concentrations	SCF soil ug-kg plant/ug-jg soil	Average Concentration in Plant ug/kg	Residential Soil Objective (Lower of inhal/inges)
Volatile Organics (ug/kg)							
Methylene Chloride	4 - 33	7 / 12	(58%)	14.7	25.000	367.86	13,000
Acetone	8 - 62	6 / 12	(50%)	22.8	8.600	196.37	7,800,000
1,1-Dichloroethane	8 - 8	1 / 12	(8%)	8.0	17.000	136.00	1,300,000
1,2-Dichloroethene (total)	220 - 220	1 / 12	(8%)	220.0	15.000	3300.00	780,000 (3)
1,2-Dichloroethane	7 - 8	2 / 12	(17%)	7.5	22.000	165.00	400
1,1,1-Trichloroethane	5 - 40	3 / 12	(25%)	18.3	7.200	132.00	1,200,000
Trichloroethene	4 - 140	2 / 12	(17%)	72.0	7.900	568.80	1,200,000
Tetrachloroethene	5 - 400	4 / 12	(33%)	121.8	2.000	243.50	11,000
1,1,2,2-Tetrachloroethane	12 - 12	1 / 12	(8%)	12.0	6.600	79.20	NA
Toluene	1 - 7	4 / 12	(33%)	3.8	5.300	19.88	650,000
Semivolatile Organics (ug/kg)							
Isophorone	150 - 150	1 / 12	(8%)	150.0	NA	NA	4,600,000
Fluoranthene	42 - 42	1 / 12	(8%)	42.0	0.081	3.40	3,100,000
Pyrene	37 - 37	1 / 12	(8%)	37.0	0.024	0.89	2,300,000
bis(2-Ethylhexyl)Phthalate	46 - 570	12 / 12	(100%)	178.3	0.044	7.85	46,000
Benzo (a) Pyrene	170 - 170	1 / 12	(8%)	170.0	0.060	10.20	90
Pesticides & PCBs (ug/kg)							
Dieldrin	5.3 - 36	3 / 12	(25%)	21.4	0.100	2.14	40
4,4'-DDE	13 - 13	1 / 12	(8%)	13.0	0.100	1.30	2,000
Endosulfan II	15 - 15	1 / 12	(8%)	15.0	1.400	21.00	470,000
4,4'-DDT	5.8 - 35	3 / 12	(25%)	17.6	0.016	0.28	2,000
Endrin aldehyde	5.1 - 33	4 / 12	(33%)	13.7	NA		23,000 (4)
gamma-Chlordane	20 - 20	1 / 12	(8%)	20.0	0.016	0.32	500
Aroclor-1260	450 - 450	1 / 12	(8%)	450.0	0.020	9.00	1,000
Inorganics (mg/Kg)							
Aluminum	8,630 - 15,800	12 / 12	(100%)	12450.8	0.004	49.80	NA
Antimony	9.4 - 12.7	7 / 12	(58%)	11.2	0.200	2.23	31
Arsenic	3.6 - 6.8	12 / 12	(100%)	5.0	0.040	0.20	0.4
Barium	41.6 - 260	12 / 12	(100%)	104.4	0.150	15.66	5,500
Beryllium	0.13 - 0.66	12 / 12	(100%)	0.3	0.010	0.003	0.1
Cadmium	1.6 - 1.6	1 / 12	(8%)	1.6	0.550	0.88	78
Calcium	929 - 27,100	12 / 12	(100%)	6114.9	3.500	21402.21	NA
Chromium	10.1 - 55.1	12 / 12	(100%)	21.7	0.008	0.16	270
Cobalt	5.2 - 11.3	12 / 12	(100%)	6.6	0.020	0.13	4,700
Copper	7.6 - 148	12 / 12	(100%)	27.8	0.400	11.13	2,900
Iron	10,600 - 19,200	12 / 12	(100%)	14791.71	0.004	59.17	NA
Lead	9.7 - 217	12 / 12	(100%)	56.2	0.045	2.53	400
Magnesium	1,400 - 17,400	12 / 12	(100%)	4439.2	1.000	4439.17	NA
Manganese	292 - 698	12 / 12	(100%)	474.8	0.250	118.69	3,700
Mercury	0.06 - 2.2	3 / 12	(25%)	0.8	0.900	0.71	10
Nickel	7.3 - 49.1	12 / 12	(100%)	15.1	0.060	0.91	1,600
Potassium	800 - 1,550	12 / 12	(100%)	1156.5	1.000	1156.50	NA
Selenium	0.92 - 1.4	8 / 12	(67%)	1.1	0.025	0.03	390
Silver	1.4 - 1.4	1 / 12	(8%)	1.4	0.400	0.56	390
Sodium	26.7 - 178	12 / 12	(100%)	91.2	0.075	6.84	NA
Thallium	1.9 - 2.1	2 / 12	(17%)	2.0	0.004	0.01	6
Vanadium	19.2 - 36.4	12 / 12	(100%)	28.8	0.006	0.16	550
Zinc	31.3 - 177	12 / 12	(100%)	67.9	1.500	101.79	23,000
Cyanide	0.25 - 2.9	6 / 12	(50%)	0.7	18.000	13.26	1,600

on a 30 year exposure and a 70 kilogram adult, a total above and below ground home grown vegetable consumption rate of 104 mg/day was converted to 45 mg-yr./kg-day, using a 30 year exposure and a 70 kilogram adult. Because the unitized consumption rate for plants is lower than that for soil, it is assumed that the Tier 1 soil concentrations could be used as surrogate risk-based concentrations for plants. Table 17 presents a comparison of estimated plant concentrations to Tier 1 soil concentrations. There are no exceedances.

Based on this evaluation, it is concluded that ingestion of vegetables (or fruits which have a fresh weight consumption rate lower than vegetables, i.e., 88 mg/day) would not result in exceedance of either a hazard index of 1.0 or a cancer risk of 1E-06 (one in one million), which are the risk limits on which the Tier 1 values are based.

4.3 Results of Tier 3 Assessment

The results of the assessment of the soil component of the groundwater ingestion pathway can be summarized as follows:

1. In Area 4, 1, 1, 1-trichloroethane, exceeded its soil remediation objective. In area 7, cis-1, 2-dichloroethene, 24-dinitrotoluene, tetrachlorene, 1,1,1-trichlorethane, trichlorethene, and total xylenes exceeded either their respective soil remediation objective or the soil saturation limit. In Area 11, benzene, ethylbenze, toluene, trichloroethene, and total xylenes exceeded either their soil remediation objective or soil saturation limit. Risks associated with these chemicals in each area of concern exceed cancer risk limits of one in one million or a hazard index of 1.0.

2. All areas where detected chemical concentrations exceeded the lower of the SRO or saturation concentration were further evaluated in the Feasibility Study.Volumes estimates were developed for these areas for excavation or remediation purposes.

Chemical data in Illinois Environmental Protection Agency (Illinois EPA) project files indicate significantly high PCE concentrations in the former outdoor drum storage area located in the west part of the property now occupied by Sundstrand Corporation Plant #1 (2421 11th Street). These data were not included as part of this risk assessment. This area is referred to as Area $9/10_w$ in this risk assessment and in the Focused Feasibility Study (FFS). PCE soil concentrations in Area $9/10_w$ significantly exceeded the Tier 3 cleanup objective of 43.5 mg/kg. Concentration contours indicate that between zero and five feet below ground surface, a hot spot area covering approximately 350 to 400 square feet exceeds the Tier 3 cleanup objective for PCE. The highest analyzed concentrations within the hot spot ranged from 47 to 3,500 mg/kg PCE. Contaminated soil within Area $9/10_w$ is addressed by the soil remedial alternatives in the FFS.

The results of the assessment of the vegetable ingestion pathway can be summarized as follows:

1. Using soil to plant concentration factors and plant ingestion rates, ingestion of vegetables would not result in exceedance of a hazard index of 1.0 or cancer risk of one in one million.

4.4 Mixture Assessment

As required by the Illinois EPA mixture rule adopted under the TACO regulations (see Docket C of the Illinois Pollution Control Board, December 4, 1997), the effect of similar acting chemicals on the same target organ was considered when determining remediation objectives. The purpose of this assessment is to determine whether the SROs are conservative enough should a mixture of chemicals be present at a site. TACO presents these requirements which are specific to each Tier of assessment. For example, when conducting a Tier 1 assessment, the effects of a mixture of either noncarcinogens or carcinogens in groundwater must be considered. When conducting a Tier 3 assessment, the effects of a mixture of either noncarcinogens or carcinogens in groundwater or soil must be considered.

A Tier 1 assessment was conducted for the direct contact with soil pathway, therefore, a mixture assessment was not necessary. A Tier 3 assessment was conducted for the soil component of the groundwater ingestion pathway. Because the soil remediation objective (SRO) for this pathway is back calculated from the Groundwater Remediation Objective (GRO) presented for Class I Groundwater in Section 742, Appendix B: Table F of TACO, the risk associated with the SRO is the risk associated with the GRO. In some cases, the risk associated with the GRO is greater than one in one million. These chemicals are identified in Section 742, Appendix A, Table H.

The cancer risks associated with the GROs used to develop the SROs for all chemicals of concern were added to determine the total cancer risk associated with the mixtures present in Areas 4, 7, 9/10 and 11 if the SROs were achieved. The following table presents the cancer risk associated with each SRO for each COC and the areas in which the COC was detected.

Chemical-Specific Concern Risk in Each Area				
	Areas			
Chemical	**4**	**7**	**9/10**	**11**
1,2-DCA	1.3E-05	1.3E-05	1.3E-05	1.3E-05
PCE	7.0E-06	7.0E-06	7.0E-06	7.0E-06
Benzene				1.0E-06
Methylene chloride	1.0E-06	1.0E-06	1.0E-06	1.0E-06
1,1,2-TA	1.0E-06	1.0E-06	1.0E-06	1.0E-06
TCE	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Total Cancer Risk	2.3E-05	2.3E-05	2.3E-05	2.3E-05

The total cancer risk if all the SROs were achieved is determined by adding the cancer risk associated with the GROs for all carcinogenic chemicals of concern in a particular area. The highest total cancer risk is 2.4 in one hundred thousand (2.4E-05) in Area 11. Per TACO, total cancer risks associated with a mixture must be less than one in one hundred thousand (1.0E-04). If the SROs are achieved, cancer risks associated with the soil to groundwater exposure pathway in all other areas are less than this risk limit.

The noncancer hazard index must be below 1.0 for all chemicals associated with noncancer health effects, which act on the sample target organ. Section 742, Appendix A: Table E of TACO lists similar - acting noncarcinogenic chemicals and their target organs. Four of the site COCs were included on this list and two, ethylbenzene and toluene, have the same target organs (kidney and liver). Ethyl benzene and xylene are COCs in two areas, Area 7 and Area 11. It was necessary to determine the hazard indices for these two chemicals to insure than the total hazard index did not exceed 1.0. In order to determine the hazard index associated with the GRO for a chemical, it was assumed a 70 kilogram adult ingested 2 liters per day of water with concentrations equal to the GRO. The dose associated with this exposure was then divided by the reference dose for the chemical.

For ethyl benzene, with a GRO of 0.7 mg/L, the daily dose is calculated as follows:

$$0.02 \text{ mg/kg/day} = \frac{0.7\text{mg/L} \times 2\text{L/day (ingestion rate)}}{70\text{kg (bodyweight)}}$$

The daily dose is then divided by the RFD to derive the hazard index for ethylbenzene:

$$0.2 = \frac{0.02\text{mg/kg/day (dose)}}{0.1\text{mg/kg/day (RFD for ethylbenzene)}}$$

The hazard index for xylene, calculated in the manner equals 0.028. When combined, the hazard index for these two chemicals equal 0.228, well below the limit of 1.0 for mixtures.

Section 5
Conclusions

A combination of a Tier 1 and Tier 3 assessment was used to assess risks at the four major source areas of the Southeast Rockford Groundwater Superfund Site. Tier 1 was used to evaluate both the direct contact pathway and the soil to groundwater pathway. Tier 3 was used to further evaluate chemicals which exceeded the Tier 1 values for the migration from soil to groundwater pathway and to evaluate the vegetable ingestion pathway.

The Tier 1 assessment resulted in the identification of PNA hot spots in Areas 4 and 11 and individual samples in Area 9/10 which exceeded one or more PNA values. If these hot spots and exceedances were removed, all remaining semi-volatile chemical concentrations would be less than the higher of the PQL or the Tier 1 concentration.

The Tier 3 assessment resulted in soil remediation objectives for volatile organic chemicals in all four areas. The Tier 3 assessment yielded concentrations that, with one exception, were higher than the Tier 1 concentrations because the Tier 3 values incorporated site-specific information. Several VOCs exceeded their respective Tier 3 SROs, the Tier 3 concentrations were used to develop a remediation plan discussed in the Focused Feasibility Study.

Using soil to plant concentration factors and plant ingestion rates, ingestion of vegetables would not result in exceedance of a hazard index of 1.0 or a cancer risk of one in one million.

APPENDIX A

BACKUP FOR TIER 3 CALCULATIONS

INFILTRATION RATES
SE ROCKFORD SOURCE CONTROL OPERABLE UNIT
RISK ASSESSMENT REPORT
JANUARY 2000

The infiltration rate of 4.445 centimeters per year (cm/yr) used in the RBCA equations is based on site-specific annual precipitation and site-specific ground conditions. Precipitation data for Rockford, Illinois (obtained from the Illinois State Water Survey) indicates annual rainfall of approximately 35 inches per year (88.9 cm/yr). The ground surface in source areas 4, 9/10, and 11 is largely paved, significantly reducing the amount of infiltration by surface water. In source area 7, the ground is unpaved, but the vadose zone soils contain significantly more silt and clay than the other source areas, which are predominantly composed of clean sand. One infiltration rate was used for all four source areas by assuming that five percent of the total annual precipitation of 88.9 cm/yr reaches the water table.

Table A-1
Variables for Tier 3 Models
Southeast Rockford - Source Control Operable Unit Risk Assessment

	RBCA Model			
I	Infiltration Rate of Water through Soil	4.445	cm/year	site-specific
f_{oc}	Fraction of Organic Carbon in Soil	0.002	g-C/g-soil	default
i_4	Hydraulic Gradient	0.008	m/m	site-specific
i_7	Hydraulic Gradient	0.01	m/m	site-specific
$i_{9/10}$	Hydraulic Gradient	0.002	m/m	site-specific
i_{11}	Hydraulic Gradient	0.002	m/m	site-specific
K	Aquifer Hydraulic Conductivity	38449	cm/yr	site-specific
W_4	Width of Source Area Parallel to Groundwater Flow	3048	cm	site-specific
W_{7p}	Width of Source Area Parallel to Groundwater Flow	4,724	cm	site-specific
W_{7d}	Width of Source Area Parallel to Groundwater Flow	10,668	cm	site-specific
$W_{9/10c}$	Width of Source Area Parallel to Groundwater Flow	6401	cm	site-specific
$W_{9/10w}$	Width of Source Area Parallel to Groundwater Flow	6096	cm	site-specific
$W_{9/10ne}$	Width of Source Area Parallel to Groundwater Flow	366	cm	site-specific
W_{11}	Width of Source Area Parallel to Groundwater Flow	8534	cm	site-specific
δ_{gw}	Groundwater Mixing Zone Thickness	200	cm	site-specific
θ_{as}	Volumetric Air Content in Vadose Soils	0.14	cm^3-air/cm^3-soil	default
θ_{ws}	Volumetric Water Content in Vadose Zone Soils	0.18	cm^3-H_2O/cm^3-soil	default
ρ_s	Soil Bulk Density	1.8	g/cm^3	default
θ_T	Total Soil Porosity	0.32	cm^3/cm^3-soil	default
H'_1	Benzene	0.228	cm3-H2O/cm3-air	
H'_2	Chlorobenzene	0.152	cm3-H2O/cm3-air	
H'_3	Chloroform	0.15	cm3-H2O/cm3-air	
H'_4	1,2-Dichloroethane	0.0401	cm3-H2O/cm3-air	
H'_5	cis-1,2-Dichloroethene	0.167	cm3-H2O/cm3-air	
H'_6	2,4-Dinitrotoluene	3.8E-06	cm3-H2O/cm3-air	
H'_7	Ethylbenzene	0.323	cm3-H2O/cm3-air	
H'_8	Methylene Chloride	0.0898	cm3-H2O/cm3-air	
H'_9	2-Methylphenol	4.92E-05	cm3-H2O/cm3-air	
H'_{10}	Tetrachloroethene	0.754	cm3-H2O/cm3-air	
H'_{11}	Toluene	0.272	cm3-H2O/cm3-air	
H'_{12}	1,1,1-Trichloroethane	0.705	cm3-H2O/cm3-air	
H'_{13}	1,1,2-Trichloroethane	0.0374	cm3-H2O/cm3-air	
H'_{14}	Trichloroethene	0.422	cm3-H2O/cm3-air	
H'_{15}	Xylenes (total)	0.25	cm3-H2O/cm3-air	
D^{air1}	Benzene	0.088	cm^2/s	
D^{air2}	Chlorobenzene	0.073	cm^2/s	
D^{air3}	Chloroform	0.104	cm^2/s	

Table A-1
Variables for Tier 3 Models
Southeast Rockford - Source Control Operable Unit Risk Assessment

D^{air4}	1,2-Dichloroethane	0.104	cm^2/s
D^{air5}	cis-1,2-Dichloroethene	0.0736	cm^2/s
D^{air6}	2,4-Dinitrotoluene	0.203	cm^2/s
D^{air7}	Ethylbenzene	0.075	cm^2/s
D^{air8}	Methylene Chloride	0.101	cm^2/s
D^{air9}	2-Methylphenol	0.074	cm^2/s
D^{air10}	Tetrachloroethene	0.072	cm^2/s
D^{air11}	Toluene	0.087	cm^2/s
D^{air12}	1,1,1-Trichloroethane	0.078	cm^2/s
D^{air13}	1,1,2-Trichloroethane	0.078	cm^2/s
D^{air14}	Trichloroethene	0.079	cm^2/s
D^{air15}	Xylenes (total)	0.072	cm^2/s
D^{wat1}	Benzene	9.80E-06	cm^2/s
D^{wat2}	Chlorobenzene	8.70E-06	cm^2/s
D^{wat3}	Chloroform	1.00E-05	cm^2/s
D^{wat4}	1,2-Dichloroethane	9.90E-06	cm^2/s
D^{wat5}	cis-1,2-Dichloroethene	1.13E-05	cm^2/s
D^{wat6}	2,4-Dinitrotoluene	7.06E-06	cm^2/s
D^{wat7}	Ethylbenzene	7.80E-06	cm^2/s
D^{wat8}	Methylene Chloride	1.17E-05	cm^2/s
D^{wat9}	2-Methylphenol	8.30E-06	cm^2/s
D^{wat10}	Tetrachloroethene	8.20E-06	cm^2/s
D^{wat11}	Toluene	8.60E-06	cm^2/s
D^{wat12}	1,1,1-Trichloroethane	8.80E-06	cm^2/s
D^{wat13}	1,1,2-Trichloroethane	8.80E-06	cm^2/s
D^{wat14}	Trichloroethene	9.10E-06	cm^2/s
D^{wat15}	Xylenes (total)	9.34E-06	cm^2/s
k_{oc1}	Benzene	58.9	cm3-H2O/g-C
k_{oc2}	Chlorobenzene	219	cm3-H2O/g-C
k_{oc3}	Chloroform	39.8	cm3-H2O/g-C
k_{oc4}	1,2-Dichloroethane	17.4	cm3-H2O/g-C
k_{oc5}	cis-1,2-Dichloroethene	35.5	cm3-H2O/g-C
k_{oc6}	2,4-Dinitrotoluene	95.5	cm3-H2O/g-C
k_{oc7}	Ethylbenzene	363	cm3-H2O/g-C
k_{oc8}	Methylene Chloride	11.7	cm3-H2O/g-C
k_{oc9}	2-Methylphenol	91.2	cm3-H2O/g-C
k_{oc10}	Tetrachloroethene	155	cm3-H2O/g-C
k_{oc11}	Toluene	182	cm3-H2O/g-C
k_{oc12}	1,1,1-Trichloroethane	110	cm3-H2O/g-C
k_{oc13}	1,1,2-Trichloroethane	50.1	cm3-H2O/g-C
k_{oc14}	Trichloroethene	166	cm3-H2O/g-C
k_{oc15}	Xylenes (total)	260	cm3-H2O/g-C

Table A-1
Variables for Tier 3 Models
Southeast Rockford - Source Control Operable Unit Risk Assessment

S_1	Benzene	1750	mg/L-H_2O
S_2	Chlorobenzene	472	mg/L-H_2O
S_3	Chloroform	7920	mg/L-H_2O
S_4	1,2-Dichloroethane	8520	mg/L-H_2O
S_5	cis-1,2-Dichloroethene	3500	mg/L-H_2O
S_6	2,4-Dinitrotoluene	270	mg/L-H_2O
S_7	Ethylbenzene	169	mg/L-H_2O
S_8	Methylene Chloride	13000	mg/L-H_2O
S_9	2-Methylphenol	26000	mg/L-H_2O
S_{10}	Tetrachloroethene	200	mg/L-H_2O
S_{11}	Toluene	526	mg/L-H_2O
S_{12}	1,1,1-Trichloroethane	1330	mg/L-H_2O
S_{13}	1,1,2-Trichloroethane	4420	mg/L-H_2O
S_{14}	Trichloroethene	1100	mg/L-H_2O
S_{15}	Xylenes (total)	186	mg/L-H_2O
GW_{obj1}	Benzene	0.005	mg/L
GW_{obj2}	Chlorobenzene	0.1	mg/L
GW_{obj3}	Chloroform	0.1	mg/L
GW_{obj4}	1,2-Dichloroethane	0.005	mg/L
GW_{obj5}	cis-1,2-Dichloroethene	0.07	mg/L
GW_{obj6}	2,4-Dinitrotoluene	0.0001	mg/L
GW_{obj7}	Ethylbenzene	0.7	mg/L
GW_{obj8}	Methylene Chloride	0.005	mg/L
GW_{obj9}	2-Methylphenol	2	mg/L
GW_{obj10}	Tetrachloroethene	0.005	mg/L
GW_{obj11}	Toluene	1	mg/L
GW_{obj12}	1,1,1-Trichloroethane	0.2	mg/L
GW_{obj13}	1,1,2-Trichloroethane	0.005	mg/L
GW_{obj14}	Trichloroethene	0.005	mg/L
GW_{obj15}	Xylenes (total)	10	mg/L
λ	Benzene	0.0009	1/day
λ	Chlorobenzene	0.0023	1/day
λ	Chloroform	0.00039	1/day
λ	1,2-Dichloroethane	0.0019	1/day
λ	cis-1,2-Dichloroethene	0.00024	1/day
λ	2,4-Dinitrotoluene	0.00192	1/day
λ	Ethylbenzene	0.00032	1/day
λ	Methylene Chloride	0.012	1/day
λ	2-Methylphenol	0.0495	1/day
λ	Tetrachloroethene	0.00096	1/day
λ	Toluene	0.011	1/day
λ	1,1,1-Trichloroethane	0.0013	1/day

Table A-1

Variables for Tier 3 Models

Southeast Rockford - Source Control Operable Unit Risk Assessment

λ	1,1,2-Trichloroethane	0.00095	1/day	
λ	Trichloroethene	0.00042	1/day	
λ	Xylenes (total)	0.0019	1/day	

Table A-2
Calculation of Leaching Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Equation R14
Calculation of LF_{sw}

Area 4	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	LF_{SW4}
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.008	200	4.445	3048	1.308625
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.008	200	4.445	3048	0.980951
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.008	200	4.445	3048	0.62022
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.008	200	4.445	3048	0.212054
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.008	200	4.445	3048	1.384246
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.008	200	4.445	3048	0.38512
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.008	200	4.445	3048	0.372013
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.008	200	4.445	3048	0.481505
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.008	200	4.445	3048	0.888608
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.008	200	4.445	3048	0.388286
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.008	200	4.445	3048	0.282251

Area 7p	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	LF_{SW7d}
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.01	200	4.445	4724	1.555221
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.01	200	4.445	4724	1.165801
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.01	200	4.445	4724	0.737093
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.01	200	4.445	4724	0.252014
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.01	200	4.445	4724	1.645092
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.01	200	4.445	4724	0.457691
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.01	200	4.445	4724	0.442115
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.01	200	4.445	4724	0.572239
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.01	200	4.445	4724	1.056056
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.01	200	4.445	4724	0.461455
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.01	200	4.445	4724	0.335439

Table A-2
Calculation of Leaching Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 7d	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	LF_{SW7p}
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.01	200	4.445	10,668	2.765665
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.01	200	4.445	10,668	2.073155
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.01	200	4.445	10,668	1.31078
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.01	200	4.445	10,668	0.448158
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.01	200	4.445	10,668	2.925483
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.01	200	4.445	10,668	0.813917
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.01	200	4.445	10,668	0.786217
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.01	200	4.445	10,668	1.017619
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.01	200	4.445	10,668	1.877995
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.01	200	4.445	10,668	0.820609
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.01	200	4.445	10,668	0.596514

Area 9/10c	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	$LF_{SW9/10c}$
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.002	200	4.445	6401	4.706566
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.002	200	4.445	6401	3.528062
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.002	200	4.445	6401	2.230665
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.002	200	4.445	6401	0.762669
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.002	200	4.445	6401	4.978541
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.002	200	4.445	6401	1.38511
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.002	200	4.445	6401	1.337971
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.002	200	4.445	6401	1.731768
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.002	200	4.445	6401	3.195942
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.002	200	4.445	6401	1.3965
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.002	200	4.445	6401	1.015138

Table A-2
Calculation of Leaching Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 9/10w	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	$LF_{SW9/10w}$
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.002	200	4.445	6096	4.625366
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.002	200	4.445	6096	3.467195
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.002	200	4.445	6096	2.192181
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.002	200	4.445	6096	0.749511
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.002	200	4.445	6096	4.892649
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.002	200	4.445	6096	1.361214
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.002	200	4.445	6096	1.314888
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.002	200	4.445	6096	1.701891
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.002	200	4.445	6096	3.140805
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.002	200	4.445	6096	1.372407
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.002	200	4.445	6096	0.997624

Area 9/10ne	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	$LF_{SW9/10ne}$
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.002	200	4.445	366	0.693609
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.002	200	4.445	366	0.519933
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.002	200	4.445	366	0.328734
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.002	200	4.445	366	0.112395
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.002	200	4.445	366	0.73369
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.002	200	4.445	366	0.204125
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.002	200	4.445	366	0.197178
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.002	200	4.445	366	0.255212
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.002	200	4.445	366	0.470988
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.002	200	4.445	366	0.205803
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.002	200	4.445	366	0.149601

Table A-2
Calculation of Leaching Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 11	ρ_s	θ_{ws}	f_{oc}	k_{oc}	H'	θ_{as}	K	i	δ_{gw}	I	W	LF_{SW11}
Benzene	1.8	0.18	0.002	59	0.228	0.14	38449	0.002	200	4.445	8534	3.020905
1,2-Dichloroethane	1.8	0.18	0.002	17	0.0401	0.14	38449	0.002	200	4.445	8534	5.159002
cis-1,2-Dichloroethene	1.8	0.18	0.002	36	0.167	0.14	38449	0.002	200	4.445	8534	3.86721
2,4-Dinitrotoluene	1.8	0.18	0.002	96	3.8E-06	0.14	38449	0.002	200	4.445	8534	2.445096
Ethylbenzene	1.8	0.18	0.002	363	0.323	0.14	38449	0.002	200	4.445	8534	0.835983
Methylene Chloride	1.8	0.18	0.002	12	0.0898	0.14	38449	0.002	200	4.445	8534	5.457122
Tetrachloroethene	1.8	0.18	0.002	155	0.754	0.14	38449	0.002	200	4.445	8534	1.518259
Toluene	1.8	0.18	0.002	182	0.272	0.14	38449	0.002	200	4.445	8534	1.466589
1,1,1-Trichloroethane	1.8	0.18	0.002	110	0.705	0.14	38449	0.002	200	4.445	8534	1.89824
1,1,2-Trichloroethane	1.8	0.18	0.002	50	0.0374	0.14	38449	0.002	200	4.445	8534	3.503164
Trichloroethene	1.8	0.18	0.002	166	0.422	0.14	38449	0.002	200	4.445	8534	1.530744
Xylenes (total)	1.8	0.18	0.002	260	0.25	0.14	38449	0.002	200	4.445	8534	1.112722

Table A-3

Calculation of Diffusion Coefficients and C_{sat}

Southeast Rockford - Source Control Operable Unit Risk Assessment

Equation S29

Calculation of C_s^{sat}

	S	ρ_s	H'	θ_{as}	θ_{ws}	f_{oc}	k_{oc}	C_s^{sat}
Benzene	1750	1.8	0.228	0.14	0.18	0.002	59	412.1833
1,2-Dichloroethane	8520	1.8	0.0401	0.14	0.18	0.002	17	1175.069
cis-1,2-Dichloroethene	3500	1.8	0.167	0.14	0.18	0.002	36	643.9611
2,4-Dinitrotoluene	270	1.8	3.8E-06	0.14	0.18	0.002	96	78.57008
Ethylbenzene	169	1.8	0.323	0.14	0.18	0.002	363	143.8397
Methylene Chloride	13000	1.8	0.0898	0.14	0.18	0.002	12	1694.998
Tetrachloroethene	200	1.8	0.754	0.14	0.18	0.002	155	93.72889
Toluene	526	1.8	0.272	0.14	0.18	0.002	182	255.1918
1,1,1-Trichloroethane	1330	1.8	0.705	0.14	0.18	0.002	110	498.5283
1,1,2-Trichloroethane	4420	1.8	0.0374	0.14	0.18	0.002	50	897.7413
Trichloroethene	1100	1.8	0.422	0.14	0.18	0.002	166	511.3044
Xylenes (total)	186	1.8	0.25	0.14	0.18	0.002	260	118.9367

Table A-4

Distance to Groundwater Management Zone (X), Source Width (Sw) and Source Thickness (Sd)
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area	Parameter					
	X (ft.)	X (cm.)	S_w (ft.)	S_w (cm.)	S_d (ft.)	S_d (cm.)
4	175	5,334	100	3,048	13	396
7p	450	13,716	200	6,096	15	457
7d	1,150	35,052	175	5,334	15	457
9/10c	700	21,336	125	3,810	10	305
9/10w	250	7,620	35	1,067	10	305
9/10ne	550	16,764	35	1,067	10	305
11	150	4,572	250	7,620	15	457

EXPLANATION

X = Distance along centerline (i.e. ***parallel to direction of groundwater flow***) of plume emanating from source

S_w = Source width perpendicular to groundwater flow direction in ***HORIZONTAL PLANE (i.e. width)***

S_d = Source width perpendicular to groundwater flow direction in ***VERTICAL PLANE (i.e. thickness)***

Area 7p = proximal to GMZ boundary (***i.e. closest to downgradient boundary***)

Area 7d = distal to GMZ boundary (***i.e. farthest from downgradient boundary***)

Area 9/10c = located in central part of Sundstrand Plant #1 (***i.e. loading dock area***)

Area 9/10ne = located at northeast end of Area 9/10 (***i.e. @ former Mid-States property***)

Area 9/10w = located at west end of Sundstrand Plant #1 (***i.e. outdoor drum storage area***)

Table A-5
Calculation of Attenuation Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Steady-State Attenuation along the centerline of a dissolved plume
Equation R15
Calculation of $C_{(x)}/C_{source}$

Area 4	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	5,334	533.4	0.0019	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.020405	0.005	0.245039
cis-1,2-Dichloroethene	5,334	533.4	0.00024	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.249361	0.07	0.280718
2,4-Dinitrotoluene	5,334	533.4	0.00192	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.019894	0.0001	0.005027
Ethylbenzene	5,334	533.4	0.00032	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.215422	0.7	3.249438
Methylene Chloride	5,334	533.4	0.012	2.633493	177.8	26.67	3,048	396	0.782	0.525	4.57E-06	0.005	1094.826
Tetrachloroethene	5,334	533.4	0.00096	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.074947	0.005	0.066714
Toluene	5,334	533.4	0.011	2.633493	177.8	26.67	3,048	396	0.782	0.525	8.58E-06	1	116536.8
1,1,1-Trichloroethane	5,334	533.4	0.0013	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.045553	0.2	4.390486
1,1,2-Trichloroethane	5,334	533.4	0.00095	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.076095	0.005	0.065707
Trichloroethene	5,334	533.4	0.00042	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.180353	0.005	0.027723
Xylenes (total)	5,334	533.4	0.0019	2.633493	177.8	26.67	3,048	396	0.782	0.525	0.020405	10	490.0774

Area 7p	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	13,716	1371.6	0.0019	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.000874	0.005	5.720157
cis-1,2-Dichloroethene	13,716	1371.6	0.00024	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.063787	0.07	1.097407
2,4-Dinitrotoluene	13,716	1371.6	0.00192	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.000839	0.0001	0.119161
Ethylbenzene	13,716	1371.6	0.00032	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.048436	0.7	14.45219
Methylene Chloride	13,716	1371.6	0.012	3.291866	457.2	68.58	6,096	457	0.609	0.236	2.65E-09	0.005	1887212
Tetrachloroethene	13,716	1371.6	0.00096	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.007459	0.005	0.670359
Toluene	13,716	1371.6	0.011	3.291866	457.2	68.58	6,096	457	0.609	0.236	6.7E-09	1	1.49E+08
1,1,1-Trichloroethane	13,716	1371.6	0.0013	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.003235	0.2	61.82083
1,1,2-Trichloroethane	13,716	1371.6	0.00095	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.007654	0.005	0.653231
Trichloroethene	13,716	1371.6	0.00042	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.034898	0.005	0.143275
Xylenes (total)	13,716	1371.6	0.0019	3.291866	457.2	68.58	6,096	457	0.609	0.236	0.000874	10	11440.31

Table A-5
Calculation of Attenuation Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 7d	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	35,052	3505.2	0.0019	3.291866	1168.4	175.26	5,334	457	0.208	0.092	1.01E-06	0.005	4944.997
cis-1,2-Dichloroethene	35,052	3505.2	0.00024	3.291866	1168.4	175.26	5,334	457	0.208	0.092	0.002915	0.07	24.01091
2,4-Dinitrotoluene	35,052	3505.2	0.00192	3.291866	1168.4	175.26	5,334	457	0.208	0.092	9.42E-07	0.0001	106.1198
Ethylbenzene	35,052	3505.2	0.00032	3.291866	1168.4	175.26	5,334	457	0.208	0.092	0.001639	0.7	427.0124
Methylene Chloride	35,052	3505.2	0.012	3.291866	1168.4	175.26	5,334	457	0.208	0.092	7.54E-16	0.005	6.63E+12
Tetrachloroethene	35,052	3505.2	0.00096	3.291866	1168.4	175.26	5,334	457	0.208	0.092	4.51E-05	0.005	110.8823
Toluene	35,052	3505.2	0.011	3.291866	1168.4	175.26	5,334	457	0.208	0.092	3.4E-15	1	2.94E+14
1,1,1-Trichloroethane	35,052	3505.2	0.0013	3.291866	1168.4	175.26	5,334	457	0.208	0.092	1E-05	0.2	19967.74
1,1,2-Trichloroethane	35,052	3505.2	0.00095	3.291866	1168.4	175.26	5,334	457	0.208	0.092	4.73E-05	0.005	105.7595
Trichloroethene	35,052	3505.2	0.00042	3.291866	1168.4	175.26	5,334	457	0.208	0.092	0.000844	0.005	5.925021
Xylenes (total)	35,052	3505.2	0.0019	3.291866	1168.4	175.26	5,334	457	0.208	0.092	1.01E-06	10	9889994

Area 9/10c	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	21,336	2133.6	0.0019	0.658373	711.2	106.68	3,810	305	0.245	0.101	4.63E-11	0.005	1.08E+08
cis-1,2-Dichloroethene	21,336	2133.6	0.00024	0.658373	711.2	106.68	3,810	305	0.245	0.101	0.00018	0.07	388.0742
2,4-Dinitrotoluene	21,336	2133.6	0.00192	0.658373	711.2	106.68	3,810	305	0.245	0.101	4.08E-11	0.0001	2452636
Ethylbenzene	21,336	2133.6	0.00032	0.658373	711.2	106.68	3,810	305	0.245	0.101	5.4E-05	0.7	12972.72
Methylene Chloride	21,336	2133.6	0.012	0.658373	711.2	106.68	3,810	305	0.245	0.101	3.08E-27	0.005	1.62E+24
Tetrachloroethene	21,336	2133.6	0.00096	0.658373	711.2	106.68	3,810	305	0.245	0.101	4.98E-08	0.005	100458.3
Toluene	21,336	2133.6	0.011	0.658373	711.2	106.68	3,810	305	0.245	0.101	4.35E-26	1	2.3E+25
1,1,1-Trichloroethane	21,336	2133.6	0.0013	0.658373	711.2	106.68	3,810	305	0.245	0.101	3.05E-09	0.2	65578456
1,1,2-Trichloroethane	21,336	2133.6	0.00095	0.658373	711.2	106.68	3,810	305	0.245	0.101	5.44E-08	0.005	91940.8
Trichloroethene	21,336	2133.6	0.00042	0.658373	711.2	106.68	3,810	305	0.245	0.101	1.4E-05	0.005	356.789
Xylenes (total)	21,336	2133.6	0.0019	0.658373	711.2	106.68	3,810	305	0.245	0.101	4.63E-11	10	2.16E+11

Table A-5
Calculation of Attenuation Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 9/10w	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	7,620	762	0.0019	0.658373	254	38.1	1,067	305	0.192	0.283	1.58E-06	0.005	3174.248
cis-1,2-Dichloroethene	7,620	762	0.00024	0.658373	254	38.1	1,067	305	0.192	0.283	0.006898	0.07	10.14761
2,4-Dinitrotoluene	7,620	762	0.00192	0.658373	254	38.1	1,067	305	0.192	0.283	1.46E-06	0.0001	68.34627
Ethylbenzene	7,620	762	0.00032	0.658373	254	38.1	1,067	305	0.192	0.283	0.003742	0.7	187.0447
Methylene Chloride	7,620	762	0.012	0.658373	254	38.1	1,067	305	0.192	0.283	4.61E-16	0.005	1.08E+13
Tetrachloroethene	7,620	762	0.00096	0.658373	254	38.1	1,067	305	0.192	0.283	8.45E-05	0.005	59.14507
Toluene	7,620	762	0.011	0.658373	254	38.1	1,067	305	0.192	0.283	2.22E-15	1	4.5E+14
1,1,1-Trichloroethane	7,620	762	0.0013	0.658373	254	38.1	1,067	305	0.192	0.283	1.74E-05	0.2	11480.92
1,1,2-Trichloroethane	7,620	762	0.00095	0.658373	254	38.1	1,067	305	0.192	0.283	8.88E-05	0.005	56.27691
Trichloroethene	7,620	762	0.00042	0.658373	254	38.1	1,067	305	0.192	0.283	0.001852	0.005	2.699412
Xylenes (total)	7,620	762	0.0019	0.658373	254	38.1	1,067	305	0.192	0.283	1.58E-06	10	6348497

Area 9/10ne	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
1,2-Dichloroethane	16,764	1676.4	0.0019	0.658373	558.8	83.82	1,067	305	0.087	0.129	3.36E-10	0.005	14889382
cis-1,2-Dichloroethene	16,764	1676.4	0.00024	0.658373	558.8	83.82	1,067	305	0.087	0.129	0.000196	0.07	357.2264
2,4-Dinitrotoluene	16,764	1676.4	0.00192	0.658373	558.8	83.82	1,067	305	0.087	0.129	3E-10	0.0001	333280.4
Ethylbenzene	16,764	1676.4	0.00032	0.658373	558.8	83.82	1,067	305	0.087	0.129	6.93E-05	0.7	10100.39
Methylene Chloride	16,764	1676.4	0.012	0.658373	558.8	83.82	1,067	305	0.087	0.129	1.65E-24	0.005	3.03E+21
Tetrachloroethene	16,764	1676.4	0.00096	0.658373	558.8	83.82	1,067	305	0.087	0.129	1.56E-07	0.005	32030.21
Toluene	16,764	1676.4	0.011	0.658373	558.8	83.82	1,067	305	0.087	0.129	1.72E-23	1	5.81E+22
1,1,1-Trichloroethane	16,764	1676.4	0.0013	0.658373	558.8	83.82	1,067	305	0.087	0.129	1.34E-08	0.2	14901816
1,1,2-Trichloroethane	16,764	1676.4	0.00095	0.658373	558.8	83.82	1,067	305	0.087	0.129	1.69E-07	0.005	29634.36
Trichloroethene	16,764	1676.4	0.00042	0.658373	558.8	83.82	1,067	305	0.087	0.129	2.16E-05	0.005	231.9221
Xylenes (total)	16,764	1676.4	0.0019	0.658373	558.8	83.82	1,067	305	0.087	0.129	3.36E-10	10	2.98E+10

Table A-5
Calculation of Attenuation Factors
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 11	X	α_x	λ	U cm/day	α_y	α_z	S_w (cm.)	S_d (cm.)	erf(1)	erf(2)	$C_{(x)}/C_{source}$	GWobj	GWsource
Benzene	4,572	457.2	0.0009	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.008764	0.005	0.570504
1,2-Dichloroethane	4,572	457.2	0.0019	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.000367	0.005	13.63107
cis-1,2-Dichloroethene	4,572	457.2	0.00024	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.159147	0.07	0.439845
2,4-Dinitrotoluene	4,572	457.2	0.00192	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.000347	0.0001	0.288125
Ethylbenzene	4,572	457.2	0.00032	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.104895	0.7	6.673334
Methylene Chloride	4,572	457.2	0.012	0.658373	152.4	22.86	7,620	457	2.282	0.707	1.91E-11	0.005	2.61E+08
Tetrachloroethene	4,572	457.2	0.00096	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.007033	0.005	0.710981
Toluene	4,572	457.2	0.011	0.658373	152.4	22.86	7,620	457	2.282	0.707	6.41E-11	1	1.56E+10
1,1,1-Trichloroethane	4,572	457.2	0.0013	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.002199	0.2	90.94383
1,1,2-Trichloroethane	4,572	457.2	0.00095	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.007293	0.005	0.685611
Trichloroethene	4,572	457.2	0.00042	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.064393	0.005	0.077648
Xylenes (total)	4,572	457.2	0.0019	0.658373	152.4	22.86	7,620	457	2.282	0.707	0.000367	10	27262.15

Table A-6
Calculation of Risk-Based Soil Level
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 4	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	0.020404941	0.005	0.245039	1.308625	0.187248935
cis-1,2-Dichloroethene	0.249360862	0.07	0.280718	0.980951	0.286168805
2,4-Dinitrotoluene	0.019893571	0.0001	0.005027	0.62022	0.008104787
Ethylbenzene	0.215421847	0.7	3.249438	0.212054	15.32361273
Methylene Chloride	4.56693E-06	0.005	1094.826	1.384246	790.9188286
Tetrachloroethene	0.074946511	0.005	0.066714	0.38512	0.173229959
Toluene	8.58098E-06	1	116536.8	0.372013	313260.1666
1,1,1-Trichloroethane	0.045553047	0.2	4.390486	0.481505	9.118254636
1,1,2-Trichloroethane	0.076095025	0.005	0.065707	0.888608	0.073944114
Trichloroethene	0.180353208	0.005	0.027723	0.388286	0.071399301
Xylenes (total)	0.020404941	10	490.0774	0.282251	1736.314619

Area 7p	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	0.000874102	0.005	5.720157	1.555221	3.67803434
cis-1,2-Dichloroethene	0.063786706	0.07	1.097407	1.165801	0.94133358
2,4-Dinitrotoluene	0.000839204	0.0001	0.119161	0.737093	0.161662782
Ethylbenzene	0.048435575	0.7	14.45219	0.252014	57.3468541
Methylene Chloride	2.64941E-09	0.005	1887212	1.645092	1147177.109
Tetrachloroethene	0.007458691	0.005	0.670359	0.457691	1.464653639
Toluene	6.70175E-09	1	1.49E+08	0.442115	337502367.7
1,1,1-Trichloroethane	0.003235156	0.2	61.82083	0.572239	108.0331689
1,1,2-Trichloroethane	0.007654257	0.005	0.653231	1.056056	0.618557384
Trichloroethene	0.034897883	0.005	0.143275	0.461455	0.310485909
Xylenes (total)	0.000874102	10	11440.31	0.335439	34105.53325

Area 7d	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	1.01112E-06	0.005	4944.997	2.765665	1787.995487
cis-1,2-Dichloroethene	0.002915341	0.07	24.01091	2.073155	11.58182183
2,4-Dinitrotoluene	9.42331E-07	0.0001	106.1198	1.31078	80.95927777
Ethylbenzene	0.001639297	0.7	427.0124	0.448158	952.8161082
Methylene Chloride	7.53795E-16	0.005	6.63E+12	2.925483	2.26735E+12
Tetrachloroethene	4.50929E-05	0.005	110.8823	0.813917	136.2329608
Toluene	3.40027E-15	1	2.94E+14	0.786217	3.74062E+14
1,1,1-Trichloroethane	1.00162E-05	0.2	19967.74	1.017619	19622.02561
1,1,2-Trichloroethane	4.72771E-05	0.005	105.7595	1.877995	56.31511884
Trichloroethene	0.000843879	0.005	5.925021	0.820609	7.220270305
Xylenes (total)	1.01112E-06	10	9889994	0.596514	16579654.76

Table A-6
Calculation of Risk-Based Soil Level
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 9/10c	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	4.63264E-11	0.005	1.08E+08	4.706566	22931763.56
cis-1,2-Dichloroethene	0.000180378	0.07	388.0742	3.528062	109.9964084
2,4-Dinitrotoluene	4.07725E-11	0.0001	2452636	2.230665	1099508.557
Ethylbenzene	5.39594E-05	0.7	12972.72	0.762669	17009.6346
Methylene Chloride	3.08458E-27	0.005	1.62E+24	4.978541	3.2559E+23
Tetrachloroethene	4.97719E-08	0.005	100458.3	1.38511	72527.26415
Toluene	4.34853E-26	1	2.3E+25	1.337971	1.71874E+25
1,1,1-Trichloroethane	3.04978E-09	0.2	65578456	1.731768	37867927.15
1,1,2-Trichloroethane	5.43828E-08	0.005	91940.8	3.195942	28767.9776
Trichloroethene	1.40139E-05	0.005	356.789	1.3965	255.4879898
Xylenes (total)	4.63264E-11	10	2.16E+11	1.015138	2.12641E+11

Area 9/10w	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	1.57518E-06	0.005	3174.248	4.625366	686.269702
cis-1,2-Dichloroethene	0.006898175	0.07	10.14761	3.467195	2.926749719
2,4-Dinitrotoluene	1.46314E-06	0.0001	68.34627	2.192181	31.17729134
Ethylbenzene	0.003742421	0.7	187.0447	0.749511	249.5557248
Methylene Chloride	4.60947E-16	0.005	1.08E+13	4.892649	2.21705E+12
Tetrachloroethene	8.45379E-05	0.005	59.14507	1.361214	43.45023967
Toluene	2.21979E-15	1	4.5E+14	1.314888	3.42609E+14
1,1,1-Trichloroethane	1.74202E-05	0.2	11480.92	1.701891	6745.981375
1,1,2-Trichloroethane	8.88464E-05	0.005	56.27691	3.140805	17.91799288
Trichloroethene	0.001852255	0.005	2.699412	1.372407	1.966917557
Xylenes (total)	1.57518E-06	10	6348497	0.997624	6363614.903

Area 9/10ne	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
1,2-Dichloroethane	3.3581E-10	0.005	14889382	0.693609	21466525.77
cis-1,2-Dichloroethene	0.000195954	0.07	357.2264	0.519933	687.0629051
2,4-Dinitrotoluene	3.00048E-10	0.0001	333280.4	0.328734	1013828.702
Ethylbenzene	6.93043E-05	0.7	10100.39	0.112395	89865.12713
Methylene Chloride	1.65113E-24	0.005	3.03E+21	0.73369	4.12739E+21
Tetrachloroethene	1.56103E-07	0.005	32030.21	0.204125	156915.0566
Toluene	1.71975E-23	1	5.81E+22	0.197178	2.94901E+23
1,1,1-Trichloroethane	1.34212E-08	0.2	14901816	0.255212	58390035.77
1,1,2-Trichloroethane	1.68723E-07	0.005	29634.36	0.470988	62919.58914
Trichloroethene	2.1559E-05	0.005	231.9221	0.205803	1126.912926
Xylenes (total)	3.3581E-10	10	2.98E+10	0.149601	1.99054E+11

Table A-6
Calculation of Risk-Based Soil Level
Southeast Rockford - Source Control Operable Unit Risk Assessment

Area 11	$C_{(x)}/C_{source}$	GWobj	GWsource	LF_{SW}	RBSLatten
Benzene	0.008764188	0.005	0.570504	3.020905	0.188851868
1,2-Dichloroethane	0.000366809	0.005	13.63107	5.159002	2.642192371
cis-1,2-Dichloroethene	0.159147054	0.07	0.439845	3.86721	0.113736962
2,4-Dinitrotoluene	0.000347072	0.0001	0.288125	2.445096	0.117837903
Ethylbenzene	0.104895099	0.7	6.673334	0.835983	7.982618287
Methylene Chloride	1.91221E-11	0.005	2.61E+08	5.457122	47914948.52
Tetrachloroethene	0.007032536	0.005	0.710981	1.518259	0.468286992
Toluene	6.41356E-11	1	1.56E+10	1.466589	10631447718
1,1,1-Trichloroethane	0.00219916	0.2	90.94383	1.89824	47.90954185
1,1,2-Trichloroethane	0.007292762	0.005	0.685611	3.503164	0.195712015
Trichloroethene	0.06439305	0.005	0.077648	1.530744	0.05072575
Xylenes (total)	0.000366809	10	27262.15	1.112722	24500.41827

APPENDIX B

DATA TABLES

Appendix B

Area 4 - Subsurface Above 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/29/93
Sample Number	SB4-2A
Organic Traffic Report Number	EXR37
Volatile Organics (ug/Kg)	
Semivolatile Organics (ug/Kg)	
Pesticides & PCBs (ug/Kg)	
gamma-BHC (Lindane)	0.12
Endosulfan II	0.22
4,4'-DDD	0.24

Appendix B

Area 7 - Subsurface Above 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	8/19/93	6/22/93	6/23/93	9/24/93
Sample Number	SB134A	SB7-5B	SB7-10A	SB7-24A
Organic Traffic Report Number	EXR71	EXR12	EXR23	EXS12
Volatile Organics (ug/Kg)	CA	CA	CA	CA
Methylene Chloride	6			
Acetone	10	10		8400
Carbon Disulfide	2			
1,1-Dichloroethene	3			
1,1-Dichloroethane	39			
1,2-Dichloroethene (total)		5	49000	
1,1,1-Trichloroethane	580	11	110000	360000
Trichloroethene	590	3	5500	24000
1,1,2-Trichloroethane	4			
Tetrachloroethene	1500	29	16000	110000
Toluene	1	23	23000	
Ethylbenzene		2	26000	15000
Styrene			1600	
Xylene		11	210000	110000
Semivolatile Organics (ug/Kg)				
Naphthalene			15000	1000
2-Methylnaphthalene			10000	1100
2,4-Dinitrotoluene			1500	
Diethylphthalate		33		
Fluorene				130
Phenanthrene				140
Di-n-Butylphthalate		49	2100	
bis(2-Ethylhexyl)Phthalate		110		1200
Pesticides & PCBs (ug/Kg)				
Heptachlor epoxide				3.3
Aroclor-1254			480	

Appendix B

Area 4 - Surface
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	9/22/93	9/22/93	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96
Sample Number	SS4-7	SS4-8	SS4-205	SS4-201	SS4-203-D	SS4-204	SS4-203	SS4-202
Organic Traffic Report Number	EXS08	EXS09	EBFY5	EBFY0	EBFY2	EBFY4	EBFY3	EBFY1
Volatile Organics (ug/kg)								
Methylene Chloride	12	18						
1,2-Dichloroethene (total)		3						
1,2-Dichloroethane	17							
1,1,1-Trichloroethane	7	110						
1,2-Dichloropropane			2		1			
Trichloroethene		25						
Toluene	11	3						
Semivolatile Organics (ug/kg)								
Naphthalene				49	260		210	
2-Methylnaphthalene				58	120		110	
Acenaphthene					960		850	
Dibenzofuran					550		420	
Fluorene					920		720	
Phenanthrene	150			570	16000		8600	420
Anthracene				72	1000		960	50
Carbazole				78	1400		1100	48
Di-n-Butylphthalate			100	66	72		51	57
Fluoranthene	170	160	81	1100	12000	44	11000	790
Pyrene	160	130		640	4700	45	5000	290
Butylbenzylphthalate				130	180		60	
Benzo(a)anthracene			53	420	5600		4700	330
Chrysene	110	100	72	580	5900		5200	400
bis(2-Ethylhexyl)Phthalate	1400	340	300	9000	320	330	300	1200
Di-n-Octyl Phthalate				67				
Benzo (b) Fluoranthene	110	110	150	1200	11000	67	9600	640
Benzo (k) Fluoranthene	84	84	160	1300	11000	70	9900	670
Benzo (a) Pyrene	140			160	860		1100	97
Ideno (1,2,3-cd) Pyrene				79	500		620	75
Dibenzo (a,h) Anthracene				41	430		390	52
Benzo (g,h,i) Perylene					56		70	
Pesticides & PCBs (ug/kg)								
delta-BHC				0.29			0.095	0.29
Aldrin			0.39				0.29	
Heptachlor epoxide	2			0.52				0.7
Endosulfan I					0.13			
Dieldrin			0.53	3.8	0.29		0.98	3.9
4,4'-DDE	3.9		0.84	1.3				0.83
Endrin							0.61	
Endosulfan II				0.4	0.35		0.2	
4,4'-DDD	4.3		0.45	0.96	1.9		0.95	0.13
4,4'-DDT	22	4.7	3.7	18				
Methoxychlor			1.2	20	26		21	5.2
Endrin ketone			0.34					0.3
Endrin aldehyde	17	9.8	0.33	1				0.61
alpha-Chlordane	3.9		0.21	3.4	0.27		0.2	2
gamma-Chlordane	2.7			1.1				
Aroclor-1254			8.4	49	30			36
Aroclor-1260	100							

Appendix B

Area 4 - Surface
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96	6/10/96	9/22/93	9/22/93
Sample Number	SS4-201	SS4-202	SS4-203-D	SS4-203	SS4-204	SS4-205	SS4-7	SS4-8
Organic Traffic Report Number	MEAPB0	MEAPB1	MEAPB2	MEAPB3	MEAPB4	MEAPB5	MEWJ98	MEWJ99
Inorganics (mg/Kg)								
Aluminum	4330	8860	2550	3860	6360	8330	11500	7580
Antimony							7.6	7.3
Arsenic	3	5.5	2.8	2.8	3.9	6.2	4.1	3.5
Barium	59.7	119	27	31.6	92	113	216	55.8
Beryllium	0.39	0.56	0.35	0.7	0.44	0.58	0.43	0.28
Cadmium	1.2	1.1	0.53	0.46		0.43	7.4	1.5
Calcium	37500	11100	131000	87600	2590	4700	27000	22900
Chromium	12.6	15.4	5.4	6.7	10.2	13.5	57.5	12.9
Cobalt	3	6.2	2.9	2.8	4.9	6	5.1	3.2
Copper	22.9	148	10.2	13.2	7.8	14.1	42.6	14.3
Iron	11400	13600	7390	13000	10000	13500	12300	9150
Lead	112	102	25.1	20.3	15.1	39.1	92	46.3
Magnesium	19100	6560	83700	54500	1530	2690	16500	13400
Manganese	489	592	313	264	477	572	452	360
Nickel	8.7	13.8	7.2	6.8	8	11.5	18.8	8.5
Potassium	600	808	296	388	426	856	1140	778
Selenium	0.92	1.1			1.1		1.2	
Silver							0.94	
Sodium	279	93.4	141	223	87.5	70.8	147	198
Thallium	1.4	2.4	1.5	1.6	1.3	1.7	1.9	
Vanadium	10.7	23.2	9.9	12.5	21.1	26.1	29.4	22.1
Zinc	742	645	89.8	89.9	34	64.9	554	64.3
Cyanide	0.35	0.46				0.23	4.8	

Appendix B

Area 7 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/21/96	6/21/96	6/21/96	6/21/96	6/21/96	9/22/93	9/22/93
Sample Number	SS7-105	SS7-102	SS7-103	SS7-104	SS7-101	SS7-1	SS7-1(D)
Organic Traffic Report Number	EBGH9	EBGJ0	EBGJ1	EBGJ2	EBGJ3	EXR99	EXS01
Volatile Organics (ug/kg)							
Methylene Chloride						13	31
Acetone						10	28
1,1-Dichloroethane							
1,2-Dichloroethene (total)							
1,2-Dichloroethane							
1,1,1-Trichloroethane		5					
Trichloroethene							
Tetrachloroethene							
1,1,2,2-Tetrachloroethane							
Toluene				1			
Semivolatile Organics (ug/kg)							
Isophorone							
Fluoranthene							
Pyrene							
bis(2-Ethylhexyl)Phthalate	46	77	49	70	53	85	240
Benzo (a) Pyrene							
Pesticides & PCBs (ug/kg)							
Dieldrin							
4,4'-DDE							
Endosulfan II							
4,4'-DDT							
Endrin aldehyde							
gamma-Chlordane							
Aroclor-1260							

Date Sampled	6/21/96	6/21/96	6/21/96	6/21/96	6/21/96	9/22/93	9/22/93
Sample Number	SS7-102	SS7-103	SS7-104	SS7-101	SS7-105	SS7-1(D)	SS7-2
Organic Traffic Report Number	MEAPJ0	MEAPJ1	MEAPJ2	MEAPJ3	MEAPH9	MEWJ91	MEWJ92
Inorganics (mg/Kg)							
Aluminum	15000	9030	9980	8630	9270	14000	15800
Antimony						9.4	11.8
Arsenic	6.8	4.3	4.4	3.6	3.9	4.9	5.8
Barium	114	67.6	61.2	56.7	41.6	82	140
Beryllium	0.66	0.15	0.22	0.13	0.15	0.33	0.43
Cadmium							
Calcium	2300	1560	9400	929	8540	2010	27100
Chromium	17.8	11.1	11.4	10.1	10.5	16	18.7
Cobalt	9.2	5.6	6.1	5.4	5.2	5.8	6.2
Copper	15.3	8.2	9.9	7.6	11.6	16.7	18.6
Iron	19200	11800	13500	10600	11800	14400	15300
Lead	22.3	12.9	10.9	12.6	14.4	10	19.9
Magnesium	2630	1530	6130	1400	4790	2450	17400
Manganese	698	400	406	391	292	452	573
Mercury	0.06						
Nickel	14.4	7.3	9.7	7.9	9.3	13.3	13.4
Potassium	1270	801	800	858	1140	1180	1550
Selenium	0.98					1	0.99
Silver							
Sodium	37.7	31.4	36.4	26.7	33.5	124	161
Thallium							
Vanadium	32.5	24.3	24.5	19.2	20.2	31.3	35.9
Zinc	54.1	31.3	35.6	32	34.6	35.7	80.5
Cyanide	0.35	0.37	0.25	0.28	0.27		

Appendix B

Area 7 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	9/22/93	9/22/93	9/22/93	9/22/93
Sample Number	SS7-3	SS7-10	SS7-21	SS7-23
Organic Traffic Report Number	EXS03	EXS04	EXS05	EXS06
Volatile Organics (ug/kg)				
Methylene Chloride	4	33	5	6
Acetone	17	62		12
1,1-Dichloroethane		8		
1,2-Dichloroethene (total)		220		
1,2-Dichloroethane	8			7
1,1,1-Trichloroethane		40		
Trichloroethene		140	4	
Tetrachloroethene		400	75	5
1,1,2,2-Tetrachloroethane		12		
Toluene	7	4		3
Semivolatile Organics (ug/kg)				
Isophorone		150		
Fluoranthene				42
Pyrene				37
bis(2-Ethylhexyl)Phthalate	170	570	310	330
Benzo (a) Pyrene		170		
Pesticides & PCBs (ug/kg)				
Dieldrin		5.3	23	
4,4'-DDE		13		
Endosulfan II		15		
4,4'-DDT		35		12
Endrin aldehyde		33	8.2	8.5
gamma-Chlordane		20		
Aroclor-1260		450		

Date Sampled	9/22/93	9/22/93	9/22/93	9/22/93
Sample Number	SS7-10	SS7-21	SS7-23	SS7-1
Organic Traffic Report Number	MEWJ94	MEWJ95	MEWJ96	MEWJ90
Inorganics (mg/Kg)				
Aluminum	14100	14200	13400	12700
Antimony	12.4	12.7	10.7	11.6
Arsenic	5.2	6.2	5.1	4.9
Barium	260	161	114	77.7
Beryllium	0.42	0.47	0.32	0.36
Cadmium	1.6			
Calcium	1990	7250	7180	1960
Chromium	55.1	46.6	31.5	15.5
Cobalt	11.3	6.9	5.9	6.2
Copper	148	30.9	34.7	16.3
Iron	18600	16600	17000	14200
Lead	180	217	151	9.7
Magnesium	2110	4830	4770	2360
Manganese	433	631	435	499
Mercury	2.2		0.11	
Nickel	49.1	14.8	16.5	12.7
Potassium	1320	1550	1270	979
Selenium	1.2	1.4	1.4	0.92
Silver	1.4			
Sodium	115	130	178	117
Thallium				2.1
Vanadium	31.1	36.4	32.4	27.5
Zinc	177	151	108	36.4
Cyanide	2.9			

Appendix B

Area 9 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96		6/25/96		6/25/96		6/25/96		6/24/96	
Sample Number	SS9/10-104		SS9/10-102		SS9/10-101		SS9/10-103		SS9/10-105(S)	
Organic Traffic Report Number	EBGK7		EBGK4		EBGK5		EBGK6		EBGK8	
Volatile Organics (ug/Kg)										
Chloromethane	11	UJ	11	U	10	U	12	UJ	110	U
Bromomethane	11	UJ	11	U	10	U	12	UJ	110	U
Vinyl Chloride	11	UJ	11	U	10	U	12	UJ	110	U
Chloroethane	11	UJ	11	U	10	U	12	UJ	110	U
Methylene Chloride	11	BJU	2	J	3	J	12	BUJ	110	BJU
Acetone	11	U	11	U	10	U	12	UJ	110	U
Carbon Disulfide	11	UJ	11	U	10	U	12	UJ	110	U
1,1-Dichloroethene	11	UJ	11	U	10	U	12	UJ	110	U
1,1-Dichloroethane	11	UJ	11	U	10	U	12	UJ	110	U
1,2-Dichloroethene (total)	11	UJ	11	U	10	U	12	UJ	110	U
Chloroform	11	UJ	11	U	10	U	12	UJ	110	U
1,2-Dichloroethane	11	UJ	11	U	10	U	12	UJ	110	U
2-Butanone	11	UJ	11	U	10	U	12	UJ	110	U
1,1,1-Trichloroethane	11	UJ	11	U	10	U	12	UJ	110	U
Carbon Tetrachloride	11	UJ	11	U	10	U	12	UJ	110	U
Bromodichloromethane	11	UJ	11	U	10	U	12	UJ	110	U
1,2-Dichloropropane	11	UJ	11	U	10	U	12	UJ	110	U
cis-1,3-Dichloropropene	11	UJ	11	U	10	U	12	UJ	110	U
Trichloroethene	11	UJ	11	U	10	U	12	UJ	110	U
Dibromochloromethane	11	UJ	11	U	10	U	12	UJ	110	U
1,1,2-Trichloroethane	11	UJ	11	U	10	U	12	UJ	110	U
Benzene	11	UJ	11	U	10	U	12	UJ	110	U
trans-1,3-Dichloropropene	11	UJ	11	U	10	U	12	UJ	110	U
Bromoform	11	UJ	11	U	10	U	12	UJ	110	U
4-Methyl-2-Pentanone	11	UJ	11	U	10	U	12	UJ	110	U
2-Hexanone	11	UJ	11	U	10	U	12	UJ	110	U
Tetrachloroethene	11	UJ	11	U	10	U	12	UJ	110	U
1,1,2,2-Tetrachloroethane	11	UJ	11	U	10	U	12	UJ	110	U
Toluene	11	UJ	11	U	10	U	12	UJ	11	J
Chlorobenzene	11	UJ	11	U	10	U	12	UJ	110	U
Ethylbenzene	11	UJ	11	U	10	U	12	UJ	110	U
Styrene	11	UJ	11	U	10	U	12	UJ	110	U
Xylene	11	UJ	11	U	10	U	12	UJ	110	U

Appendix B

Area 9 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96		6/25/96		6/25/96		6/25/96		6/24/96	
Sample Number	SS9/10-104		SS9/10-102		SS9/10-101		SS9/10-103		SS9/10-105(S)	
Organic Traffic Report Number	EBGK7		EBGK4		EBGK5		EBGK6		EBGK8	
Semivolatile Organics (ug/Kg)										
Phenol	1500	U	430	U	1700	U	1800	U		
bis(2-Chloroethyl)Ether	1500	U	430	U	1700	U	1800	U		
2-Chlorophenol	1500	U	430	U	1700	U	1800	U		
1,3-Dichlorobenzene	1500	U	430	U	1700	U	1800	U		
1,4-Dichlorobenzene	1500	U	430	U	1700	U	1800	U		
1,2-Dichlorobenzene	1500	U	430	U	1700	U	1800	U		
2-Methylphenol	1500	U	430	U	1700	U	1800	U		
2,2'-oxybis(1-Chloropropane)	1500	U	430	UJ	1700	UJ	1800	UJ		
4-Methylphenol	1500	U	430	U	1700	U	1800	U		
N-Nitroso-Di-n-Propylamine	1500	U	430	U	1700	U	1800	U		
Hexachloroethane	1500	U	430	U	1700	U	1800	U		
Nitrobenzene	1500	U	430	U	1700	U	1800	U		
Isophorone	1500	U	430	U	1700	U	1800	U		
2-Nitrophenol	1500	U	430	U	1700	U	1800	U		
2,4-Dimethylphenol	1500	U	430	U	1700	U	1800	U		
bis(2-Chloroethoxy)Methane	1500	U	430	U	1700	U	1800	U		
2,4-Dichlorophenol	1500	U	430	U	1700	U	1800	U		
1,2,4-Trichlorobenzene	1500	U	430	U	1700	U	1800	U		
Naphthalene	1500	U	430	U	1700	U	320	J		
4-Chloroaniline	1500	U	430	UJ	1700	UJ	1800	UJ		
Hexachlorobutadiene	1500	U	430	U	1700	U	1800	U		
4-Chloro-3-Methylphenol	1500	U	430	U	1700	U	1800	U		
2-Methylnaphthalene	1500	U	430	U	1700	U	250	J		
Hexachlorocyclopentadiene	1500	U	430	U	1700	U	1800	U		
2,4,6-Trichlorophenol	1500	U	430	U	1700	U	1800	U		
2,4,5-Trichlorophenol	3700	U	1100	U	4400	U	4600	U		
2-Chloronaphthalene	1500	U	430	U	1700	U	1800	U		
2-Nitroaniline	3700	U	1100	U	4400	U	4600	U		
Dimethylphthalate	1500	U	430	U	1700	U	1800	U		
Acenaphthylene	1500	U	430	U	1700	U	1800	U		
2,6-Dinitrotoluene	1500	U	430	U	1700	U	1800	U		
3-Nitroaniline	3700	U	1100	UJ	4400	UJ	4600	UJ		
Acenaphthene	350	J	430	U	1700	U	200	J		
2,4-Dinitrophenol	3700	U	1100	U	4400	U	4600	U		

Appendix B

Area 9 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96		6/25/96		6/25/96		6/25/96		6/24/96	
Sample Number	SS9/10-104		SS9/10-102		SS9/10-101		SS9/10-103		SS9/10-105(S)	
Organic Traffic Report Number	EBGK7		EBGK4		EBGK5		EBGK6		EBGK8	
4-Nitrophenol	3700	U	1100	U	4400	U	4600	U		
Dibenzofuran	190	J	430	U	1700	U	1800	U		
2,4-Dinitrotoluene	1500	U	430	U	1700	U	1800	U		
Diethylphthalate	1500	U	430	U	1700	U	1800	U		
4-Chlorophenyl-phenylether	1500	U	430	U	1700	U	1800	U		
Fluorene	340	J	430	U	1700	U	190	J		
4-Nitroaniline	3700	U	1100	U	4400	U	4600	U		
4,6-Dinitro-2-Methylphenol	3700	U	1100	U	4400	U	4600	U		
N-Nitrosodiphenylamine (1)	1500	U	430	U	1700	U	1800	U		
4-Bromophenyl-phenylether	1500	U	430	U	1700	U	1800	U		
Hexachlorobenzene	1500	U	430	U	1700	U	1800	U		
Pentachlorophenol	3700	UJ	1100	U	4400	U	4600	U		
Phenanthrene	3600	J	400	J	2100	J	2600	J		
Anthracene	640	J	55	J	190	J	540	J		
Carbazole	530	J	59	J	250	J	340	J		
Di-n-Butylphthalate	1600	J	430	U	1700	U	1200	J		
Fluoranthene	4800	J	650		4400	J	4200	J		
Pyrene	4200	J	580		3400	J	3500	J		
Butylbenzylphthalate	1500	U	60	J	1700	U	660	J		
3,3'-Dichlorobenzidine	1500	UJ	430	UJ	1700	UJ	1800	UJ		
Benzo(a)anthracene	2300	J	330	J	1400	J	1900	J		
Chrysene	2100	J	310	J	1800	J	1900	J		
bis(2-Ethylhexyl)Phthalate	3900	J	130	J	460	J	7400	J		
Di-n-Octyl Phthalate	1500	U	430	U	1700	U	1800	U		
Benzo (b) Fluoranthene	2800	J	420	J	2700	J	2800	J		
Benzo (k) Fluoranthene	740	J	220	J	790	J	890	J		
Benzo (a) Pyrene	1700	J	260	J	1600	J	1700	J		
Ideno (1,2,3-cd) Pyrene	1200	J	230	J	1000	J	1300	J		
Dibenzo (a,h) Anthracene	1500	U	430	U	1700	U	1800	U		
Benzo (g,h,i) Perylene	1300	J	270	J	1100	J	1400	J		

Appendix B

Area 9 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96		6/25/96		6/25/96		6/25/96		6/24/96	
Sample Number	SS9/10-104		SS9/10-102		SS9/10-101		SS9/10-103		SS9/10-105(S)	
Organic Traffic Report Number	EBGK7		EBGK4		EBGK5		EBGK6		EBGK8	
Pesticides & PCBs (ug/Kg)										
alpha-BHC	1.9	U	2.2	U	1.8	U	1.9	U		
beta-BHC	1.9	U	2.2	U	1.8	U	1.9	U		
delta-BHC	1.9	U	2.2	U	1.8	U	1.9	U		
gamma-BHC (Lindane)	1.9	U	2.2	U	1.8	U	1.9	U		
Heptachlor	1.9	U	2.2	U	1.8	U	1.9	U		
Aldrin	1.9	U	2.2	U	1.8	U	1.9	U		
Heptachlor epoxide	1.9	U	2.5		1.8	U	1.9	U		
Endosulfan I	1.9	U	2.2	U	1.8	U	1.9	U		
Dieldrin	4.1	PJ	54	P	3.4	U	3.6	U		
4,4'-DDE	17	J	4.3	U	3.4	U	3.6	U		
Endrin	3.7	U	4.3	U	3.4	U	3.6	U		
Endosulfan II	3.7	U	4.3	U	3.4	U	3.6	U		
4,4'-DDD	7.1	J	4.3	U	3.4	U	3.6	U		
Endosulfan sulfate	3.7	U	4.3	U	3.4	U	3.6	U		
4,4'-DDT	41	J	4.3	U	3.4	U	7	J		
Methoxychlor	19	U	22	U	18	U	19	U		
Endrin ketone	3.7	U	4.3	U	3.4	U	3.6	U		
Endrin aldehyde	3.7	U	4.3	U	3.4	U	3.6	U		
alpha-Chlordane	1.9	U	2.2	U	1.8	U	1.9	U		
gamma-Chlordane	2	PJ	2.2	U	1.8	U	1.9	U		
Toxaphene	190	U	220	U	180	U	190	U		
Aroclor-1016	37	U	43	U	34	U	36	U		
Aroclor-1221	74	U	87	U	70	U	73	U		
Aroclor-1232	37	U	43	U	34	U	36	U		
Aroclor-1242	37	U	43	U	34	U	36	U		
Aroclor-1248	37	U	43	U	34	U	36	U		
Aroclor-1254	30	J	43	U	34	U	36	U		
Aroclor-1260	37	U	43	U	34	U	36	U		

Appendix B

Area 11 - Surface

Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/11/96	6/11/96	6/11/96	6/11/96	6/11/96	6/24/96	6/24/96
Sample Number	SS11-204	SS11-205	SS11-201	SS11-202	SS11-203	SS11-207	SS11-206
Organic Traffic Report Number	EBFZ9	EBGA0	EBFZ6	EBFZ7	EBFZ8	EBGK3	EBGK2
Volatile Organics (ug/Kg)							
No Hits							
Semivolatile Organics (ug/Kg)							
Naphthalene	42					15000	
2-Methylnaphthalene	45						
Acenaphthene	70					39000	
Dibenzofuran	57					33000	
Fluorene	130					47000	
Phenanthrene	820	83	54	88	120	370000	4300
Anthracene	160					93000	
Carbazole	65					67000	
Di-n-Butylphthalate	190	110	160		94		5200
Fluoranthene	1300	160	110	160	280	440000	8700
Pyrene	280				57	430000	7600
Butylbenzylphthalate				44			
Benzo(a)anthracene	770	79	69	85	140	200000	3200
Chrysene	570	79	52	75	140	240000	3800
bis(2-Ethylhexyl)Phthalate	3100	880	2600	24000	11000	40000	37000
Di-n-Octyl Phthalate				100	66		
Benzo (b) Fluoranthene	680	86	99	87	240	220000	3500
Benzo (k) Fluoranthene	380	50	100	46	270	130000	2400
Benzo (a) Pyrene	96					150000	2400
Ideno (1,2,3-cd) Pyrene	63					120000	2100
Dibenzo (a,h) Anthracene	70						
Benzo (g,h,i) Perylene						120000	2000
Pesticides & PCBs (ug/Kg)							
delta-BHC		0.38			0.24		
Heptachlor						13	
Aldrin					0.69		2.3
Heptachlor epoxide	0.54					24	
Endosulfan I	0.64						
Dieldrin	6.6	0.31	0.11	0.21	0.67		10
4,4'-DDE	3.5		0.79				
Endrin		0.68			1.2		
Endosulfan II	3.2		0.36				
4,4'-DDD	2.1			0.34		12	
4,4'-DDT					0.94		
Methoxychlor	30	4.6	6.5	9.4	7.7		
Endrin ketone	1.1					11	
Endrin aldehyde	0.82			0.47		9.7	
alpha-Chlordane	2.9	0.5	0.35	0.36	0.54	120	
gamma-Chlordane						180	3
Aroclor-1254	530		57	31	31		
Aroclor-1260						350	450

Appendix B

Area 4 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/28/93	6/28/93	6/29/93	6/29/93	6/29/93	6/29/93	6/29/93	6/29/93	6/12/96	6/12/96	6/12/96	6/27/96	6/12/96
Sample Number	SB4-1D	SB4-1F	SB4-2D	SB4-3E	SB4-3E(D)	SB4-4E	SB4-5E	SB4-5F	SB4-105(S)	SB4-102(S)	SB4-102(D)	SB4-201-16	SB4-104(S)
Organic Traffic Report Number	EXR35	EXR36	EXR38	EXR39	EXR40	EXR41	EXR42	EXR43	EBGB0	EBGA3	EBGA4	EBGP1	EBGA7
Volatile Organics (ug/Kg)	CA	CA	CA	CA	CA	CA	CA	CA					
Methylene Chloride												4	
Acetone			5	7	6		9						
1,1,1-Trichloroethane		360000	5			9	6	190000				2	
Benzene				2									
Tetrachloroethene				1									
Toluene				41	26	2	12						
Chlorobenzene				2	2	2							
Semivolatile Organics (ug/Kg)				-	-	-							
Naphthalene		3000						470					
2-Methylnaphthalene		1600											
Phenanthrene		580											
bis(2-Ethylhexyl)Phthalate	260		53			150	23						
Pesticides & PCBs (ug/Kg)			-		-								
alpha-BHC		2.8						4					
beta-BHC		5.9											
delta-BHC		1.8											
gamma-BHC (Lindane)	0.14	1.6											
Heptachlor		1.6						5.2					
Aldrin		2.3											
Endosulfan I		5.7						5.6					
4,4'-DDE				0.34		0.31	0.21						
Endosulfan II	0.2	0.18					0.17	0.44					
4,4'-DDD													
4,4'-DDT								0.59					
Methoxychlor		3.7											
Endrin aldehyde		0.78						1.5					

Appendix B

Area 4 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/12/96	6/12/96	6/12/96	6/12/96	6/27/96	6/12/96	6/12/96	6/12/96	6/12/96	6/13/96	6/12/96	6/12/96
Sample Number	SB4-104(S)-D	SB4-106(S)	SB4-107(S)	SB4-107(D)	SB4-202-8	SB4-104(D)	SB4-103(S)	SB4-101(S)	SB4-105(D)	SB4-106(D)	SB4-101(D)	SB4-103(D)
Organic Traffic Report Number	EBGA8	EBGB2	EBGB4	EBGB5	EBGR3	EBGA9	EBGA5	EBGA1	EBGB1	EBGB3	EBGA2	EBGA6
Volatile Organics (ug/Kg)												
Methylene Chloride												
Acetone												
1,1,1-Trichloroethane					510000							
Benzene												
Tetrachloroethene												
Toluene												
Chlorobenzene												
Semivolatile Organics (ug/Kg)												
Naphthalene												
2-Methylnaphthalene												
Phenanthrene												
bis(2-Ethylhexyl)Phthalate												
Pesticides & PCBs (ug/Kg)												
alpha-BHC												
beta-BHC												
delta-BHC												
gamma-BHC (Lindane)												
Heptachlor												
Aldrin												
Endosulfan I												
4,4'-DDE												
Endosulfan II												
4,4'-DDD												
4,4'-DDT												
Methoxychlor												
Endrin aldehyde												

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/21/93	6/21/93	6/21/93	6/21/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93
Sample Number	SB7-1E	SB7-1F	SB7-2F	SB7-2D	SB7-3F	SB7-3G	SB7-4E	SB7-4H	SB7-5B	SB7-5E	SB7-5E(D)	SB7-6F	SB7-6H
Organic Traffic Report Number	EXR04	EXR05	EXR06	EXR07	EXR08	EXR09	EXR10	EXR11	EXR12	EXR13	EXR14	EXR15	EXR16
Volatile Organics (ug/Kg)	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA
Methylene Chloride													
Acetone	8	22						18	10			25	10
1,1-Dichloroethene													
1,1-Dichloroethane	23	2	13	13	10	29		18			240		
1,2-Dichloroethene (total)	170	99	12	130	39	56	700	130	5	1700	8800	64	9
Chloroform													
1,2-Dichloroethane			29					2					
2-Butanone													
1,1,1-Trichloroethane	79	22	57	110	62	55	6500	220	11	5300	26000	35	14
Trichloroethene	2		8		11	7	2400	66	3	630	3000	2	
1,1,2-Trichloroethane													
Benzene													
4-Methyl-2-Pentanone			3					11					
Tetrachloroethene	6	2	3	5	27	10	17000	95	29	8400	24000	32	14
Toluene	1		13	13	2	9	2000	77	23	320	1000	8	2
Chlorobenzene													
Ethylbenzene				6			990	9	2	520	1300	13	
Styrene													
Xylene			2	32			6200	49	11	3400	8900	88	11
Semivolatile Organics (ug/Kg)													
4-Methylphenol	31												
Isophorone													
Naphthalene												160	61
2-Methylnaphthalene												55	53
2,4-Dinitrotoluene													
Diethylphthalate	27					31		45	33			29	29
Fluorene													
Phenanthrene							43	35					

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/21/93	6/21/93	6/21/93	6/21/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93	6/22/93
Sample Number	SB7-1E	SB7-1F	SB7-2F	SB7-2D	SB7-3F	SB7-3G	SB7-4E	SB7-4H	SB7-5B	SB7-5E	SB7-5E(D)	SB7-6F	SB7-6H
Organic Traffic Report Number	EXR04	EXR05	EXR06	EXR07	EXR08	EXR09	EXR10	EXR11	EXR12	EXR13	EXR14	EXR15	EXR16
Anthracene							43						
Di-n-Butylphthalate	34	30	33	28	31	67	79	87	49	650	790	79	100
Fluoranthene								22					
Pyrene								24					
bis(2-Ethylhexyl)Phthalate	100	100	65	45	170	46	350	330	110		630	110	85
Di-n-Octyl Phthalate					23								
Pesticides & PCBs (ug/Kg)													
alpha-BHC													
gamma-BHC (Lindane)													
Heptachlor													
Aldrin													
Heptachlor epoxide													
Dieldrin													
4,4'-DDE													
Endosulfan II													
4,4'-DDD													
Endosulfan sulfate													
4,4'-DDT													
Methoxychlor													
Endrin aldehyde													
alpha-Chlordane													
gamma-Chlordane													
Aroclor-1232													
Aroclor-1242										170	140	37	21
Aroclor-1254												13	7.8
Aroclor-1260	58												

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/24/93	6/24/93	6/24/93	6/24/93	6/24/93	6/29/93
Sample Number	SB7-7I	SB7-7F	SB7-8D	SB7-8I	SB7-9E	SB7-9J	SB7-10A	SB7-11D	SB7-12D	SB7-12D(D	SB7-13E	SB7-13E(D	SB7-14C
Organic Traffic Report Number	EXR-17	EXR18	EXR19	EXR20	EXR21	EXR22	EXR23	EXR25	EXR26	EXR27	EXR28	EXR29	EXR44
Volatile Organics (ug/Kg)	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA
Methylene Chloride													
Acetone	140							23	9	18			
1,1-Dichloroethene													
1,1-Dichloroethane	18							7					
1,2-Dichloroethene (total)	260	970	15000		7200	4	49000	240	1	2		11	35
Chloroform													
1,2-Dichloroethane													
2-Butanone													
1,1,1-Trichloroethane	530	25000	380000	190	66000	5	110000	100	21	32		130	8
Trichloroethene	340	10000	130000	150	58000	6	5500	8	3	4		8	
1,1,2-Trichloroethane													
Benzene													
4-Methyl-2-Pentanone													
Tetrachloroethene	920	24000	260000	1200	100000	7	16000	5	12	9	2	35	49
Toluene	140	2100	23000		12000	1	23000	4	1	2	4	2	19
Chlorobenzene													
Ethylbenzene	120	2900	31000	200	14000		26000	1					
Styrene							1600						
Xylene	930	18000	180000	1200	100000	6	210000	5					
Semivolatile Organics (ug/Kg)													
4-Methylphenol													
Isophorone													
Naphthalene	55	3800	11000		13000	31	15000						
2-Methylnaphthalene	35	2500	7300		5700		10000						
2,4-Dinitrotoluene							1500						
Diethylphthalate	41	1800				21		32	30	26	64		
Fluorene													
Phenanthrene													

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/23/93	6/24/93	6/24/93	6/24/93	6/24/93	6/24/93	6/29/93
Sample Number	SB7-7I	SB7-7F	SB7-8D	SB7-8I	SB7-9E	SB7-9J	SB7-10A	SB7-11D	SB7-12D	SB7-12D(D	SB7-13E	SB7-13E(D	SB7-14C
Organic Traffic Report Number	EXR-17	EXR18	EXR19	EXR20	EXR21	EXR22	EXR23	EXR25	EXR26	EXR27	EXR28	EXR29	EXR44
Anthracene													
Di-n-Butylphthalate	84	1400	840		1700	40	2100	42	43	38	41	44	
Fluoranthene													
Pyrene													
bis(2-Ethylhexyl)Phthalate	57					44		90	91	110			76
Di-n-Octyl Phthalate									22	29			
Pesticides & PCBs (ug/Kg)													
alpha-BHC													
gamma-BHC (Lindane)													
Heptachlor													
Aldrin													
Heptachlor epoxide													
Dieldrin													
4,4'-DDE													0.35
Endosulfan II													
4,4'-DDD													
Endosulfan sulfate													
4,4'-DDT													
Methoxychlor													
Endrin aldehyde													
alpha-Chlordane													
gamma-Chlordane													
Aroclor-1232		250	490										
Aroclor-1242													
Aroclor-1254	8.9	410	1400		2500	5.6	480						
Aroclor-1260													

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/29/93	9/23/93	9/23/93	9/24/93	9/24/93	10/12/93	10/13/93	10/14/93	6/13/96	6/13/96	6/13/96	6/13/96
Sample Number	SB7-14D	SB7-15A	SB7-17A	SB7-24A	SB7-24B	SB7-19B	SB7-22D	SB7-23G	SB7-103(S	SB7-106(D	SB7-103(D	SB7-104(S
Organic Traffic Report Number	EXR45	EXS10	EXS11	EXS12	EXS13	EXT08	EXT09	EXT10	EBGC0	EBGC7	EBGC1	EBGC2
Volatile Organics (ug/Kg)	CA	CA	CA	CA	CA	CA	CA	CA				
Methylene Chloride					12							
Acetone		11	11	8400	27			8				
1,1-Dichloroethene			8		4							
1,1-Dichloroethane			12		190							
1,2-Dichloroethene (total)			61		9		10000		4			
Chloroform												
1,2-Dichloroethane			5		180							
2-Butanone	1500				13							
1,1,1-Trichloroethane	770		280	360000	51	2200	30000		1			
Trichloroethene			48	24000	21		960					
1,1,2-Trichloroethane												
Benzene												
4-Methyl-2-Pentanone					82							
Tetrachloroethene	24000		200	110000	22		8800	14				
Toluene					4	250	1500					
Chlorobenzene												
Ethylbenzene				15000		1700	4400					
Styrene												
Xylene	2300			110000	19	13000	19000					
Semivolatile Organics (ug/Kg)												
4-Methylphenol												
Isophorone					880							
Naphthalene	710			1000								
2-Methylnaphthalene				1100								
2,4-Dinitrotoluene												
Diethylphthalate												
Fluorene				130								
Phenanthrene				140								

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/29/93	9/23/93	9/23/93	9/24/93	9/24/93	10/12/93	10/13/93	10/14/93	6/13/96	6/13/96	6/13/96	6/13/96
Sample Number	SB7-14D	SB7-15A	SB7-17A	SB7-24A	SB7-24B	SB7-19B	SB7-22D	SB7-23G	SB7-103(S	SB7-106(D	SB7-103(D	SB7-104(S
Organic Traffic Report Number	EXR45	EXS10	EXS11	EXS12	EXS13	EXT08	EXT09	EXT10	EBGC0	EBGC7	EBGC1	EBGC2
Anthracene												
Di-n-Butylphthalate												
Fluoranthene												
Pyrene												
bis(2-Ethylhexyl)Phthalate		120	130	1200	240							
Di-n-Octyl Phthalate												
Pesticides & PCBs (ug/Kg)												
alpha-BHC	0.28											
gamma-BHC (Lindane)	0.68											
Heptachlor	0.13											
Aldrin	15											
Heptachlor epoxide	2.8			3.3								
Dieldrin	2.1											
4,4'-DDE	12											
Endosulfan II	6.2											
4,4'-DDD	1											
Endosulfan sulfate	0.33											
4,4'-DDT	4											
Methoxychlor	4.4				33							
Endrin aldehyde	1.7											
alpha-Chlordane	9.8											
gamma-Chlordane	1.3											
Aroclor-1232												
Aroclor-1242												
Aroclor-1254	430											
Aroclor-1260												

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/14/96	6/21/96	6/21/96	6/14/96
Sample Number	SB7-104(D	SB7-105(S	SB7-105(D	SB7-106(S	SB7-107(S	SB7-107(D	SB7-108(D	SB7-109(S	SB7-109(D	SB7-108(S
Organic Traffic Report Number	EBGC3	EBGC4	EBGC5	EBGC6	EBGC8	EBGC9	EBGD9	EBGH7	EBGH8	EBGD8
Volatile Organics (ug/Kg)										
Methylene Chloride										
Acetone										
1,1-Dichloroethene										
1,1-Dichloroethane										
1,2-Dichloroethene (total)						21				
Chloroform										
1,2-Dichloroethane										
2-Butanone										
1,1,1-Trichloroethane		2	1			40				
Trichloroethene										
1,1,2-Trichloroethane										
Benzene										
4-Methyl-2-Pentanone						9				
Tetrachloroethene		1			3					
Toluene						3				
Chlorobenzene										
Ethylbenzene						5				
Styrene										
Xylene						40				
Semivolatile Organics (ug/Kg)										
4-Methylphenol										
Isophorone										
Naphthalene										
2-Methylnaphthalene										
2,4-Dinitrotoluene										
Diethylphthalate										
Fluorene										
Phenanthrene										

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/13/96	6/14/96	6/21/96	6/21/96	6/14/96
Sample Number	SB7-104(D	SB7-105(S	SB7-105(D	SB7-106(S	SB7-107(S	SB7-107(D	SB7-108(D	SB7-109(S	SB7-109(D	SB7-108(S
Organic Traffic Report Number	EBGC3	EBGC4	EBGC5	EBGC6	EBGC8	EBGC9	EBGD9	EBGH7	EBGH8	EBGD8
Anthracene										
Di-n-Butylphthalate										
Fluoranthene										
Pyrene										
bis(2-Ethylhexyl)Phthalate										
Di-n-Octyl Phthalate										
Pesticides & PCBs (ug/Kg)										
alpha-BHC										
gamma-BHC (Lindane)										
Heptachlor										
Aldrin										
Heptachlor epoxide										
Dieldrin										
4,4'-DDE										
Endosulfan II										
4,4'-DDD										
Endosulfan sulfate										
4,4'-DDT										
Methoxychlor										
Endrin aldehyde										
alpha-Chlordane										
gamma-Chlordane										
Aroclor-1232										
Aroclor-1242										
Aroclor-1254										
Aroclor-1260										

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/13/96	6/13/96	6/13/96	6/13/96	6/25/96	6/25/96	6/26/96
Sample Number	SB7-101(S	SB7-101(D	SB7-102(S	SB7-102(D	SB7-201-1	SB7-202-6	SB7-202-6-D
Organic Traffic Report Number	EBGB6	EBGB7	EBGB8	EBGB9	EBGL9	EBGM0	EBGM1
Volatile Organics (ug/Kg)							
Methylene Chloride							
Acetone							
1,1-Dichloroethene					1300		
1,1-Dichloroethane					2900		
1,2-Dichloroethene (total)				7	47000		
Chloroform					570		
1,2-Dichloroethane							
2-Butanone							
1,1,1-Trichloroethane				2	460000	1100	1600
Trichloroethene					96000	240	
1,1,2-Trichloroethane					460		
Benzene					220		
4-Methyl-2-Pentanone							
Tetrachloroethene					23000	1100	2500
Toluene					23000	7500	14000
Chlorobenzene						1600	
Ethylbenzene					31000	13000	28000
Styrene							
Xylene					190000	57000	140000
Semivolatile Organics (ug/Kg)							
4-Methylphenol							
Isophorone							
Naphthalene							
2-Methylnaphthalene							
2,4-Dinitrotoluene							
Diethylphthalate							
Fluorene							
Phenanthrene							

Appendix B

Area 7 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/13/96	6/13/96	6/13/96	6/13/96	6/25/96	6/25/96	6/26/96
Sample Number	SB7-101(S	SB7-101(D	SB7-102(S	SB7-102(D	SB7-201-1	SB7-202-6	SB7-202-6-D
Organic Traffic Report Number	EBGB6	EBGB7	EBGB8	EBGB9	EBGL9	EBGM0	EBGM1
Anthracene							
Di-n-Butylphthalate							
Fluoranthene							
Pyrene							
bis(2-Ethylhexyl)Phthalate							
Di-n-Octyl Phthalate							
Pesticides & PCBs (ug/Kg)							
alpha-BHC							
gamma-BHC (Lindane)							
Heptachlor							
Aldrin							
Heptachlor epoxide							
Dieldrin							
4,4'-DDE							
Endosulfan II							
4,4'-DDD							
Endosulfan sulfate							
4,4'-DDT							
Methoxychlor							
Endrin aldehyde							
alpha-Chlordane							
gamma-Chlordane							
Aroclor-1232							
Aroclor-1242							
Aroclor-1254							
Aroclor-1260							

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	7/13/93	7/13/93	6/24/96	7/1/96	7/2/96	6/24/96	6/24/96	6/24/96	6/24/96	6/24/96	6/24/96
Sample Number	SB9-1F	SB9-1FD	SB9/10-115(S	SB9/10-202-1	SB9/10-203-2	SB9/10-110(S	B9/10-110(D	SB9/10-111(S	B9/10-111(D	SB9/10-112(S	B9/10-112(D
Organic Traffic Report Number	EXR56	EXR57	EBGK8	EBGR4	EBGR8	EBGJ4	EBGJ5	EBGJ6	EBGJ7	EBGJ8	EBGJ9
Volatile Organics (ug/Kg)											
Methylene Chloride											
Acetone											
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone				5							
1,1,1-Trichloroethane					1						
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene	5	5			8						
Toluene			11								1
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	7/13/93	7/13/93	6/24/96	7/1/96	7/2/96	6/24/96	6/24/96	6/24/96	6/24/96	6/24/96	6/24/96
Sample Number	SB9-1F	SB9-1FD	SB9/10-115(S	SB9/10-202-1	SB9/10-203-2	SB9/10-110(S	B9/10-110(D	SB9/10-111(S	B9/10-111(D	SB9/10-112(S	B9/10-112(D
Organic Traffic Report Number	EXR56	EXR57	EBGK8	EBGR4	EBGR8	EBGJ4	EBGJ5	EBGJ6	EBGJ7	EBGJ8	EBGJ9
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled	7/9/96		7/2/96								
Sample Number	SB9/10-205-5		SB9/10-203-22								
Organic Traffic Report Number	MEAPL5		MEAPL8								
Inorganics (mg/Kg)											
Aluminum	1180		957	*							
Antimony	0.69	U	3.8	BN							
Arsenic	0.67	B	0.81	B							
Barium	4.7	B	4.5	B							
Beryllium	0.06	B	0.09	U							
Cadmium	0.1	B	0.55	U							
Calcium	43500		42900								
Chromium	4.4		3.1	*							
Cobalt	1.3	B	1.2	B							
Copper	3.5	B	2.8	B							
Iron	3090		2600	*							
Lead	2		1.5								
Magnesium	18100		17100	*							
Manganese	89.3		79.6								
Mercury	0.06	U	0.05	U							
Nickel	3.5	B	3.6	B							
Potassium	215	B	146	B							
Selenium	0.48	U	0.18	U							
Silver	1	U	0.48	UN							
Sodium	65.2	B	113	B							
Thallium	0.65	B	0.16	B							
Vanadium	4.4	B	5.1	B							
Zinc	7.7		6.6								
Cyanide	0.04	U	0.17	B							

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/24/96	6/24/96	6/26/96	6/27/96	6/27/96	6/27/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96
Sample Number	SB9/10-113(S	B9/10-113(D	B9/10-131(D	SB9/10-122(S	B9/10-122(D	SB9/10-132(S	B9/10-118(D	SB9/10-117(S	B9/10-117(D	SB9/10-116(S	B9/10-116(D
Organic Traffic Report Number	EBGK0	EBGK1	EBGP3	EBGP4	EBGP5	EBGP6	EBGM9	EBGN0	EBGN1	EBGN2	EBGN3
Volatile Organics (ug/Kg)											
Methylene Chloride			6	8			5	6	6	6	
Acetone											
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone								10			
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene									2		
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/24/96	6/24/96	6/26/96	6/27/96	6/27/96	6/27/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96
Sample Number	SB9/10-113(S	B9/10-113(D	B9/10-131(D	SB9/10-122(S	B9/10-122(D	SB9/10-132(S	B9/10-118(D	SB9/10-117(S	B9/10-117(D	SB9/10-116(S	B9/10-116(D
Organic Traffic Report Number	EBGK0	EBGK1	EBGP3	EBGP4	EBGP5	EBGP6	EBGM9	EBGN0	EBGN1	EBGN2	EBGN3
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)					2.3						
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT				6.4							
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/25/96	6/25/96	6/25/96	6/25/96
Sample Number	SB9/10-130(S	SB9/10-120(S	B9/10-130(D	B9/10-118(S)-	SB9/10-119(S	B9/10-119(D	B9/10-120(D	SB9/10-129(S	B9/10-129(D	SB9/10-126(S	B9/10-126(D
Organic Traffic Report Number	EBGN4	EBGN5	EBGN6	EBGN7	EBGN8	EBGN9	EBGP0	EBGL5	EBGL6	EBGL7	EBGL8
Volatile Organics (ug/Kg)											
Methylene Chloride	5	5	5	6	5	5	6				
Acetone								6	4	2	6
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone											
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene				1	2	4		5			6
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/26/96	6/25/96	6/25/96	6/25/96	6/25/96
Sample Number	SB9/10-130(S	SB9/10-120(S	B9/10-130(D	B9/10-118(S)-	SB9/10-119(S	B9/10-119(D	B9/10-120(D	SB9/10-129(S	B9/10-129(D	SB9/10-126(S	B9/10-126(D
Organic Traffic Report Number	EBGN4	EBGN5	EBGN6	EBGN7	EBGN8	EBGN9	EBGP0	EBGL5	EBGL6	EBGL7	EBGL8
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96	6/25/96	6/25/96	6/25/96	6/26/96	6/26/96	6/26/96	6/24/96	6/24/96	6/24/96	6/25/96
Sample Number	SB9/10-114(S	B9/10-114(D	SB9/10-128(S	B9/10-128(D	SB9/10-121(S	B9/10-121(D	SB9/10-118(S	SB9/10-115(S	B9/10-115(S)-	B9/10-115(D	SB9/10-127(S
Organic Traffic Report Number	EBGM2	EBGM3	EBGM4	EBGM5	EBGM6	EBGM7	EBGM8	EBGK8	EBGK9	EBGL0	EBGL1
Volatile Organics (ug/Kg)											
Methylene Chloride											
Acetone	4	5									
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone				5			4				
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene	1							11	13		3
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96	6/25/96	6/25/96	6/25/96	6/26/96	6/26/96	6/26/96	6/24/96	6/24/96	6/24/96	6/25/96
Sample Number	SB9/10-114(S	B9/10-114(D	SB9/10-128(S	B9/10-128(D	SB9/10-121(S	B9/10-121(D	SB9/10-118(S	SB9/10-115(S	B9/10-115(S)-	B9/10-115(D	SB9/10-127(S
Organic Traffic Report Number	EBGM2	EBGM3	EBGM4	EBGM5	EBGM6	EBGM7	EBGM8	EBGK8	EBGK9	EBGL0	EBGL1
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96	6/25/96	6/25/96	6/27/96	6/27/96	6/28/96	6/28/96	6/28/96	6/28/96	6/28/96	6/28/96
Sample Number	B9/10-127(D	SB9/10-125(S	B9/10-125(D	SB9/10-139(S	B9/10-140(D	B9/10-142(D	B9/10-141(D	SB9/10-141(S	B9/10-141(S)-	B9/10-124(D	SB9/10-124(S
Organic Traffic Report Number	EBGL2	EBGL3	EBGL4	EBGQ4	EBGQ5	EBGQ6	EBGQ7	EBGQ8	EBGQ9	EBGR0	EBGR1
Volatile Organics (ug/Kg)											
Methylene Chloride											
Acetone	3	2	9		5						
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone											
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene	18	3	1								
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/25/96	6/25/96	6/25/96	6/27/96	6/27/96	6/28/96	6/28/96	6/28/96	6/28/96	6/28/96	6/28/96
Sample Number	B9/10-127(D	SB9/10-125(S	B9/10-125(D	SB9/10-139(S	B9/10-140(D	B9/10-142(D	B9/10-141(D	SB9/10-141(S	B9/10-141(S)-	B9/10-124(D	SB9/10-124(S
Organic Traffic Report Number	EBGL2	EBGL3	EBGL4	EBGQ4	EBGQ5	EBGQ6	EBGQ7	EBGQ8	EBGQ9	EBGR0	EBGR1
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/28/96	7/9/96	7/9/96	7/10/96	7/10/96	7/10/96	7/10/96	7/10/96	7/10/96	6/20/96	6/20/96
Sample Number	SB9/10-20	SB9/10-205-	SB9/10-204-1	SB9/10-134(S	B9/10-134(D	SB9/10-135(S	B9/10-135(D	SB9/10-137(S	B9/10-137(D	B9/10-107(D	SB9/10-107(S
Organic Traffic Report Number	EBGR2	EBGS5	EBGS0	EBGS6	EBGS7	EBGS8	EBGS9	EBGT0	EBGT1	EBGG9	EBGH0
Volatile Organics (ug/Kg)											
Methylene Chloride		10	10	4	48	3	3	3	3		
Acetone		9	11								
1,1-Dichloroethene		2									
1,2-Dichloroethene (total)	5	86									
2-Butanone											
1,1,1-Trichloroethane	5	50					2				
Trichloroethene				1		1	2	2			
1,1,2-Trichloroethane		6									
Tetrachloroethene				20		7	46	2			
Toluene							3				
Xylene			4								
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate	70									44	78
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/28/96	7/9/96	7/9/96	7/10/96	7/10/96	7/10/96	7/10/96	7/10/96	7/10/96	6/20/96	6/20/96
Sample Number	SB9/10-20	SB9/10-205-	SB9/10-204-1	SB9/10-134(S	B9/10-134(D	SB9/10-135(S	B9/10-135(D	SB9/10-137(S	B9/10-137(D	B9/10-107(D	SB9/10-107(S
Organic Traffic Report Number	EBGR2	EBGS5	EBGS0	EBGS6	EBGS7	EBGS8	EBGS9	EBGT0	EBGT1	EBGG9	EBGH0
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/20/96	6/20/96	6/20/96	6/20/96	6/19/96	6/29/96	6/29/96	6/19/96	6/20/96	6/20/96	6/27/96
Sample Number	B9/10-105(D	SB9/10-105(S	B9/10-101(D	SB9/10-101(S	B9/10-104(D	SB9/10-104(S	B9/10-103(D	SB9/10-103(S	SB9/10-109(S	B9/10-109(D	SB9/10-142(S
Organic Traffic Report Number	EBGG8	EBGG7	EBGG4	EBGG3	EBGG2	EBGG1	EBGG0	EBGF9	EBGH1	EBGH2	EBGP8
Volatile Organics (ug/Kg)											
Methylene Chloride											
Acetone			8					8			
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone											
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene											
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene							420				
2-Methylnaphthalene							300				
Acenaphthene							220				
Dibenzofuran							150				
Fluorene							120				
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate											
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/20/96	6/20/96	6/20/96	6/20/96	6/19/96	6/29/96	6/29/96	6/19/96	6/20/96	6/20/96	6/27/96
Sample Number	B9/10-105(D	SB9/10-105(S	B9/10-101(D	SB9/10-101(S	B9/10-104(D	SB9/10-104(S	B9/10-103(D	SB9/10-103(S	SB9/10-109(S	B9/10-109(D	SB9/10-142(S
Organic Traffic Report Number	EBGG8	EBGG7	EBGG4	EBGG3	EBGG2	EBGG1	EBGG0	EBGF9	EBGH1	EBGH2	EBGP8
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin						3.8					
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/21/96	6/21/96	6/21/96	6/21/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/20/96
Sample Number	SB9/10-108(S	B9/10-108(D	SB9/10-106(S	B9/10-106(D	SB9/10-123(S	B9/10-123(D	B9/10-139(D	B9/10-123(S)-	B9/10-132(D	SB9/10-140(S	B9/10-102(D
Organic Traffic Report Number	EBGH3	EBGH4	EBGH5	EBGH6	EBGP9	EBGQ0	EBGQ1	EBGQ2	EBGQ3	EBGP7	EBGG6
Volatile Organics (ug/Kg)											
Methylene Chloride											
Acetone											
1,1-Dichloroethene											
1,2-Dichloroethene (total)											
2-Butanone										4	
1,1,1-Trichloroethane											
Trichloroethene											
1,1,2-Trichloroethane											
Tetrachloroethene											
Toluene											
Xylene											
Semivolatile Organics (ug/Kg)											
Naphthalene											
2-Methylnaphthalene											
Acenaphthene											
Dibenzofuran											
Fluorene											
Phenanthrene											
Anthracene											
Carbazole											
Di-n-Butylphthalate											
Fluoranthene											
Pyrene											
Butylbenzylphthalate											
Benzo(a)anthracene											
Chrysene											
bis(2-Ethylhexyl)Phthalate	45		6900								
Benzo (b) Fluoranthene											
Benzo (k) Fluoranthene											
Benzo (a) Pyrene											
Ideno (1,2,3-cd) Pyrene											
Benzo (g,h,i) Perylene											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/21/96	6/21/96	6/21/96	6/21/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/27/96	6/20/96
Sample Number	SB9/10-108(S	B9/10-108(D	SB9/10-106(S	B9/10-106(D	SB9/10-123(S	B9/10-123(D	B9/10-139(D	B9/10-123(S)-	B9/10-132(D	SB9/10-140(S	B9/10-102(D
Organic Traffic Report Number	EBGH3	EBGH4	EBGH5	EBGH6	EBGP9	EBGQ0	EBGQ1	EBGQ2	EBGQ3	EBGP7	EBGG6
Pesticides & PCBs (ug/Kg)											
gamma-BHC (Lindane)											
Heptachlor epoxide											
Dieldrin											
4,4'-DDE											
Endrin											
4,4'-DDD											
4,4'-DDT											
gamma-Chlordane											
Aroclor-1254											
Date Sampled											
Sample Number											
Organic Traffic Report Number											
Inorganics (mg/Kg)											
Aluminum											
Antimony											
Arsenic											
Barium											
Beryllium											
Cadmium											
Calcium											
Chromium											
Cobalt											
Copper											
Iron											
Lead											
Magnesium											
Manganese											
Mercury											
Nickel											
Potassium											
Selenium											
Silver											
Sodium											
Thallium											
Vanadium											
Zinc											
Cyanide											

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/20/96
Sample Number	SB9/10-102(S
Organic Traffic Report Number	EBGG5
Volatile Organics (ug/Kg)	
Methylene Chloride	
Acetone	
1,1-Dichloroethene	
1,2-Dichloroethene (total)	
2-Butanone	
1,1,1-Trichloroethane	
Trichloroethene	
1,1,2-Trichloroethane	
Tetrachloroethene	
Toluene	
Xylene	
Semivolatile Organics (ug/Kg)	
Naphthalene	
2-Methylnaphthalene	
Acenaphthene	
Dibenzofuran	
Fluorene	
Phenanthrene	
Anthracene	
Carbazole	
Di-n-Butylphthalate	
Fluoranthene	
Pyrene	
Butylbenzylphthalate	
Benzo(a)anthracene	
Chrysene	
bis(2-Ethylhexyl)Phthalate	
Benzo (b) Fluoranthene	
Benzo (k) Fluoranthene	
Benzo (a) Pyrene	
Ideno (1,2,3-cd) Pyrene	
Benzo (g,h,i) Perylene	

Appendix B

Area 9/10 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/20/96
Sample Number	SB9/10-102(S
Organic Traffic Report Number	EBGG5
Pesticides & PCBs (ug/Kg)	
gamma-BHC (Lindane)	[redacted]
Heptachlor epoxide	
Dieldrin	
4,4'-DDE	
Endrin	
4,4'-DDD	
4,4'-DDT	
gamma-Chlordane	
Aroclor-1254	
Date Sampled	
Sample Number	
Organic Traffic Report Number	
Inorganics (mg/Kg)	
Aluminum	
Antimony	
Arsenic	
Barium	
Beryllium	
Cadmium	
Calcium	
Chromium	
Cobalt	
Copper	
Iron	
Lead	
Magnesium	
Manganese	
Mercury	
Nickel	
Potassium	
Selenium	
Silver	
Sodium	
Thallium	
Vanadium	
Zinc	
Cyanide	

Appendix B

Area 11 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	8/25/93	8/25/93	8/25/93	8/25/93	8/26/93	8/26/93	8/26/93	8/27/93	8/27/93	8/30/93	8/30/93	8/30/93	8/31/93	8/31/93	8/31/93	9/1/93	9/1/93
Sample Number	SB11-1	SB11-1J	SB11-1J(D)	SB11-2	SB11-3	SB11-5	SB11-5K	SB11-4	SB11-4L	SB11-8	SB11-8	SB11-8I(D)	SB11-6	SB11-6	SB11-9	SB11-7	SB11-7K
Organic Traffic Report Number	EXR76	EXR77	EXR78	EXR79	EXR80	EXR81	EXR82	EXR83	EXR84	EXR85	EXR86	EXR87	EXR88	EXR89	EXR90	EXR91	EXR92
Volatile Organics (ug/Kg)																	
Methylene Chloride		13	1		3				3	2200	2100	2900	24	30	53		
Acetone		44		9	8								7	6			
Carbon Disulfide														1	3		2
2-Butanone																	
1,1,1-Trichloroethane									2					3			
Trichloroethene																410	
Benzene									5								
Tetrachloroethene					46												
Toluene	930000	130		2	1	230000		290000	72	43000			9	2		150000	3
Ethylbenzene	56000	6			3	150000										64000	
Xylene	200000	21			8	530000	760	17000	15	2000						310000	8
Semivolatile Organics (ug/Kg)																	
2-Methylphenol	470							450	60	580		160	120				
4-Methylphenol	540							300		640			100				
Isophorone														100			
2-Nitrophenol																	
bis(2-Chloroethoxy)Methane																230	
Naphthalene	1400					150		80								1000	
2-Methylnaphthalene	52					130		73								120	
Phenanthrene							16	21							47		
Anthracene															45		
Di-n-Butylphthalate												510					
Fluoranthene															49		
Pyrene										63							
bis(2-Ethylhexyl)Phthalate	560					1300	1100			110						690	
Di-n-Octyl Phthalate																250	260
Pesticides & PCBs (ug/Kg)																	
alpha-BHC	0.57					0.96		0.23									
gamma-BHC (Lindane)									0.18								
Aldrin						0.29											
4,4'-DDE	0.26			0.54	0.68												
Endosulfan II	0.34																
4,4'-DDD								0.29									
4,4'-DDT	0.56			0.3		0.43	0.45										
Endrin aldehyde								0.49									
alpha-Chlordane	0.18																

Appendix B

Area 11 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	9/1/93	9/1/93	7/3/96	6/29/96	6/30/96	6/30/96	6/17/96	6/17/96	6/17/96	6/17/96	6/17/96	6/17/96	6/17/96
Sample Number	SB11-10	SB11-10	B11-204-2	SB11-201-29	B11-203-1	SB11-202-9	SB11-105(S)	SB11-105(D)	SB11-106(S)	SB11-106(D)	SB11-107(S)	B11-107(S)-	B11-107(D
Organic Traffic Report Number	EXR93	EXR94	EBGR9	EBGR5	EBGR6	EBGR7	EBGE0	EBGE1	EBGE2	EBGE3	EBGE4	EBGE5	EBGE6
Volatile Organics (ug/Kg)													
Methylene Chloride													
Acetone					5100			4		2	3		3
Carbon Disulfide		2											
2-Butanone				4									
1,1,1-Trichloroethane				4									
Trichloroethene													
Benzene	1500												
Tetrachloroethene													
Toluene	1400000	12			180000	180000							
Ethylbenzene	590000	2			20000	120000							
Xylene	2300000	23	2	1	110000	650000							
Semivolatile Organics (ug/Kg)													
2-Methylphenol		120											
4-Methylphenol		61											
Isophorone	1400												
2-Nitrophenol	1100												
bis(2-Chloroethoxy)Methane													
Naphthalene	1900												
2-Methylnaphthalene	140												
Phenanthrene													
Anthracene													
Di-n-Butylphthalate													
Fluoranthene													
Pyrene													
bis(2-Ethylhexyl)Phthalate	720												
Di-n-Octyl Phthalate		45											
Pesticides & PCBs (ug/Kg)													
alpha-BHC													
gamma-BHC (Lindane)													
Aldrin													
4,4'-DDE													
Endosulfan II													
4,4'-DDD													
4,4'-DDT													
Endrin aldehyde													
alpha-Chlordane													

Appendix B

Area 11 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/17/96	6/17/96	6/17/96	6/17/96	6/17/96	6/17/96	6/18/96	6/18/96	6/18/96	6/18/96	6/18/96	6/18/96
Sample Number	SB11-109(S	SB11-109(D)	SB11-110(S)	SB11-110(D	SB11-108(S)	SB11-108(D)	SB11-111(S)	SB11-111(D)	SB11-112(S)	SB11-112(D)	SB11-113-(S)	SB11-113(D)
Organic Traffic Report Number	EBGE7	EBGE8	EBGE9	EBGF0	EBGF1	EBGF2	EBGF3	EBGF4	EBGF5	EBGF6	EBGF7	EBGF8
Volatile Organics (ug/Kg)												
Methylene Chloride												
Acetone				4	4	3						
Carbon Disulfide												
2-Butanone												
1,1,1-Trichloroethane												
Trichloroethene												
Benzene												
Tetrachlorcethene									1	2		
Toluene												
Ethylbenzene												
Xylene												
Semivolatile Organics (ug/Kg)												
2-Methylphenol												
4-Methylphenol												
Isophorone												
2-Nitrophenol												
bis(2-Chloroethoxy)Methane												
Naphthalene												
2-Methylnaphthalene												
Phenanthrene												
Anthracene												
Di-n-Butylphthalate												
Fluoranthene												
Pyrene												
bis(2-Ethylhexyl)Phthalate												
Di-n-Octyl Phthalate												
Pesticides & PCBs (ug/Kg)												
alpha-BHC												
gamma-BHC (Lindane)												
Aldrin												
4,4'-DDE												
Endosulfan II												
4,4'-DDD												
4,4'-DDT												
Endrin aldehyde												
alpha-Chlordane												

Appendix B

Area 11 - Subsurface Below 10 feet
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	6/20/96	6/20/96	6/14/96	6/14/96	6/14/96	6/14/96	6/14/96	6/14/96	6/14/96	6/14/96
Sample Number	SB9/10-102(D)	B9/10-102(S	SB11-101(S)	SB11-101(D)	SB11-102(S)	SB11-102(D)	SB11-103(S)	SB11-103(D)	SB11-104(S)	SB11-104(D)
Organic Traffic Report Number	EBGG6	EBGG5	EBGD0	EBGD1	EBGD2	EBGD3	EBGD4	EBGD5	EBGD6	EBGD7
Volatile Organics (ug/Kg)										
Methylene Chloride										
Acetone										
Carbon Disulfide										
2-Butanone										
1,1,1-Trichloroethane										
Trichloroethene										
Benzene										
Tetrachloroethene										
Toluene										
Ethylbenzene										
Xylene										
Semivolatile Organics (ug/Kg)										
2-Methylphenol										
4-Methylphenol										
Isophorone										
2-Nitrophenol										
bis(2-Chloroethoxy)Methane										
Naphthalene										
2-Methylnaphthalene										
Phenanthrene										
Anthracene										
Di-n-Butylphthalate										
Fluoranthene										
Pyrene										
bis(2-Ethylhexyl)Phthalate										
Di-n-Octyl Phthalate										
Pesticides & PCBs (ug/Kg)										
alpha-BHC										
gamma-BHC (Lindane)										
Aldrin										
4,4'-DDE										
Endosulfan II										
4,4'-DDD										
4,4'-DDT										
Endrin aldehyde										
alpha-Chlordane										

APPENDIX C

BACKUP FOR CALCULATION OF 95% UCLS

Table C-1
Upper Confidence Limits for Area 4 Surface Soil

			Original UCL				Re-Calculated UCL				
Analytes	Minimum Concentrations	Maximum Concentrations	Mean (y)	Standard deviation (sy)	H(1-a)	Lognormal Distribution UCL (95%)	Mean (y)	Standard deviation (s_y)	$H_{(1-a)}$	Lognormal Distribution UCL (95%)	Maximum Concentration
PAHs (ug/kg)											
Benzo(a)anthracene	53	5600	6.07	1.65	5.27	44220	5.08	0.671	3.553	663	330
Benzo(b)Fluoranthene	67	11000	6.33	2.04	6.41	623453	5.02	0.858	4.303	1380	640
Benzo(k)Fluoranthene	70	11000	6.30	2.10	6.60	932833	4.94	0.932	4.615	1851	670
Benzo(a)Pyrene	97	1100	5.51	0.88	3.19	1047	5.05	0.299	2.400	234	200

Notes:
Equation used for lognormal distribution[1]:

$$UL_{(1-a)} = Exp(y+0.5*(s_y)^2+s_y*H_{(1-a)}/(n-1)^{1/2})$$

Where:
a = confidence level
y = mean
s_y = standard deviation
H(1-a) = variable dependent on a, y, and s_y

1. Reference book used for equation is by Richard Gilbert, "Statistical Methods For Environmental Pollution Monitoring", 1987, p. 170.

* H value for anthracene based on a standard deviation of 1.0. The actual standard deviation for anthracene did not have an H value associated with it.

** Sample points SS4-201, SS4-203, and SS4-203D were removed from the re-calculated UCL as hot spots

Table C-2
Detections for Area 9 Surface Soil

Analytes	SS910-104	SS910-102	SS910-101	SS910-103
PAHs (ug/kg)				
Benzo(a)anthracene	**2300**	330	**1400**	**1900**
Benzo(b)Fluoranthene	**2800**	420	**2700**	**2800**
Benzo(a)Pyrene	**1700**	260	**1600**	**1700**
Indeno(1,2,3-cd)pyrene	**1200**	230	**1000**	**1300**

Notes:

* Not enough sample points to run UCL test

** All exceedances are bolded

Table C-3
Upper Confidence Limits for Area 11 Surface Soil

			Original UCL				Re-Calculated UCL				
Analytes	Minimum Concentrations	Maximum Concentrations	Mean (y)	Standard deviation (sy)	H(1-a)	Lognormal Distribution UCL (95%)	Mean (y)	Standard deviation (s_y)	$H_{(1-a)}$	Lognormal Distribution Mean UCL (95%)	Maximum Concentration
PAHs (ug/kg)											
Benzo(a)anthracene	69	200000	6.42	2.93	9.70	4751532520	4.93	0.998	4.90	2613.2	770
Chrysene	52	240000	6.37	3.05	10.1	17963930946	4.79	0.942	4.66	1672.9	570
Benzo(b)Fluoranthene	86	220000	6.57	2.87	9.52	3054767046	5.10	0.900	4.48	1852.1	680
Benzo(k)Fluoranthene	46	130000	6.21	2.81	9.34	1161455752	4.78	0.962	4.74	1846.4	380

Notes:

Equation used for lognormal distribution[1]:

$$UL_{(1-a)} = \text{Exp}(y+0.5*(s_y)^2+s_y*H_{(1-a)}/(n-1)^{1/2})$$

Where:

a = confidence level

y = mean

s_y = standard deviation

H(1-a) = variable dependent on a, y, and s_y

1. Reference book used for equation is by Richard Gilbert, "Statistical Methods For Environmental Pollution Monitoring", 1987, p. 170.

* H value for anthracene based on a standard deviation of 1.0. The actual standard deviation for anthracene did not have an H value associated with it.

** Sample points SS11-206 and SS11-207 were removed from the re-calculated UCL as hot spots

APPENDIX D

CALCULATIONS OF BACKGROUND CONCENTRATIONS

TABLE D-1
SOUTHEAST ROCKFORD
CALCULATION OF LOGNORMAL DISTRIBUTION 95% UPPER CONFIDENCE INTERVAL FOR PAHS

Analytes	Minimum Concentrations	Maximum Concentrations	Mean (y)	Standard deviation (s_y)	$H_{(1-a)}$	Lognormal Distribution UCL (95%)
PAHs (ug/kg)						
Naphthalene	175	850	5.36	0.419	2.027567	296.5
2-Methylnaphthalene	175	850	5.36	0.419	2.027567	296.5
Acenaphthene	175	850	5.36	0.419	2.027567	296.5
Acenaphthylene	175	850	5.36	0.419	2.027567	296.5
Fluorene	175	850	5.36	0.419	2.027567	296.5
Phenanthrene	150	2100	5.42	0.676	2.34512	446.4
Anthracene	175	205	5.24	0.049	1.766333	194.5
Fluoranthene	44	4400	5.30	1.03	2.91268	808.8
Pyrene	45	3400	5.35	0.927	2.734143	670.0
Benzo(a)anthracene	53	1400	5.30	0.684	2.35608	401.1
Chrysene	72	1800	5.30	0.724	2.41392	431.2
Benzo(b)Fluoranthene	67	2700	5.31	0.84	2.591933	538.8
Benzo(k)Fluoranthene	70	790	5.20	0.557	2.187537	301.2
Benzo(a)Pyrene	140	1600	5.39	0.605	2.24785	389.0
Indeno(1,2,3-cd)Pyrene	175	1000	5.37	0.464	2.077067	316.7
Dibenzo(a,h)anthracene	175	850	5.36	0.419	2.027567	296.5
Benzo(g,h,i)Perylene	175	1100	5.38	0.49	2.105667	329.3

Notes:

Equation used for lognormal distribution[1]:

$$UL_{(1-a)} = \text{Exp}(y+0.5*(s_y)^2+s_y*H_{(1-a)}/(n-1)^{1/2})$$

Where:
a = confidence level
y = mean
s_y = standard deviation
H(1-a) = variable dependent on a, y, and s_y

1. Reference book used for equation is by Richard Gilbert, "Statistical Methods For Environmental Pollution Monitoring", 1987, p. 170.

* H value for anthracene based on a standard deviation of 1.0. The actual standard deviation for anthracene did not have an H value associated with it.

Table D-2
Background Surface Samples
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	9/22/93		9/22/93		9/22/93		6/25/96	
Sample Number	SS7-1(D)		SS7-2		SS7-3		SS9/10-101	
Organic Traffic Report Number	EXS01	DL	EXS02	DL	EXS03	DL	EBGK5	DL
Semivolatile Organics (ug/kg)								
Naphthalene	ND	370	ND	370	ND	360	ND	1700
2-Methylnaphthalene	ND	370	ND	370	ND	360	ND	1700
Acenaphthene	ND	370	ND	370	ND	360	ND	1700
Acenaphthylene	ND	370	ND	370	ND	360	ND	1700
Fluorene	ND	370	ND	370	ND	360	ND	1700
Phenanthrene	ND	370	ND	370	ND	360	2100	
Anthracene	ND	370	ND	370	ND	360	190	
Fluoranthene	ND	370	ND	370	ND	360	4400	
Pyrene	ND	370	ND	370	ND	360	3400	
Benzo(a)anthracene	ND	370	ND	370	ND	360	1400	
Chrysene	ND	370	ND	370	ND	360	1800	
Benzo (b) Fluoranthene	ND	370	ND	370	ND	360	2700	
Benzo (k) Fluoranthene	ND	370	ND	370	ND	360	790	
Benzo (a) Pyrene	ND	370	ND	370	ND	360	1600	
Indeno (1,2,3-cd) Pyrene	ND	370	ND	370	ND	360	1000	
Dibenzo (a,h) Anthracene	ND	370	ND	370	ND	360	ND	1700
Benzo (g,h,i) Perylene	ND	370	ND	370	ND	360	1100	

Table D-2
Background Surface Samples
Southeast Rockford - Source Control Operable Unit Risk Assessment

Date Sampled	9/22/93		6/10/96		6/10/96		6/21/96		6/21/96		6/21/96		6/21/96		6/21/96		9/22/93	
Sample Number	SS4-7		SS4-205		SS4-204		SS7-105		SS7-102		SS7-103		SS7-104		SS7-101		SS7-1	
Organic Traffic Report Number	EXS08	DL	EBFY5	DL	EBFY4	DL	EBGH9	DL	EBGJ0	DL	EBGJ1	DL	EBGJ2	DL	EBGJ3	DL	EXR99	DL
Semivolatile Organics (ug/kg)																		
Naphthalene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
2-Methylnaphthalene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Acenaphthene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Acenaphthylene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Fluorene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Phenanthrene	150		ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Anthracene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Fluoranthene	170		81		44		ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Pyrene	160		ND	400	45		ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Benzo(a)anthracene	ND	360	53		ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Chrysene	110		72		ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Benzo (b) Fluoranthene	110		150		67		ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Benzo (k) Fluoranthene	84		160		70		ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Benzo (a) Pyrene	140		ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Indeno (1,2,3-cd) Pyrene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Dibenzo (a,h) Anthracene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370
Benzo (g,h,i) Perylene	ND	360	ND	400	ND	380	ND	400	ND	400	ND	410	ND	380	ND	350	ND	370

Variable	N-of-Cases	MaxDif	Lilliefors Probability (2-tail)
NAPH	13.000	0.500	0.0
LNNAPH	13.000	0.457	0.0
METHYLN	13.000	0.500	0.0
LNMETHY	13.000	0.457	0.0
ACETHYL	13.000	0.500	0.0
LNACEYL	13.000	0.457	0.0
ACENAP	13.000	0.500	0.0
LNACENAP	13.000	0.457	0.0
FLRENE	13.000	0.500	0.0
LNFLRENE	13.000	0.457	0.0
PHENAN	13.000	0.519	0.0
LNPHEN	13.000	0.477	0.0
ANTHRA	13.000	0.177	0.336
LNANTH	13.000	0.176	0.343
FLRANTH	13.000	0.520	0.0
LNFLRTH	13.000	0.414	0.000
PYRENE	13.000	0.520	0.0
LNPYR	13.000	0.433	0.000
BAANTH	13.000	0.500	0.0
LNBAANTH	13.000	0.407	0.000
CHRYSENE	13.000	0.505	0.0
LNCHRY	13.000	0.411	0.000
BBFLUOR	13.000	0.513	0.0
LNBBFL	13.000	0.416	0.000
BKFLUOR	13.000	0.448	0.000
LNBKFL	13.000	0.336	0.000
BAPYR	13.000	0.514	0.0
LNBAPYR	13.000	0.466	0.0
INDENO	13.000	0.506	0.0
LNINDEN	13.000	0.465	0.0
DIBENZO	13.000	0.500	0.0
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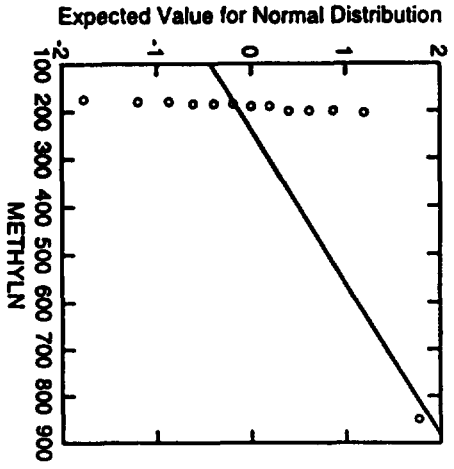
BGHIPER	13.000	0.509	0.0
LNBGHIP	13.000	0.469	0.0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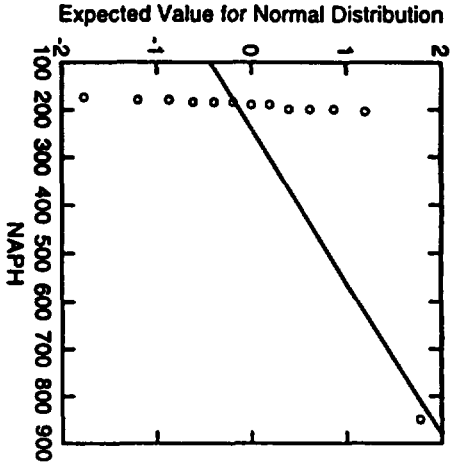
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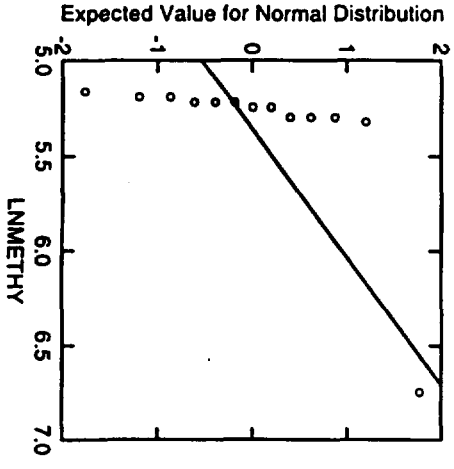
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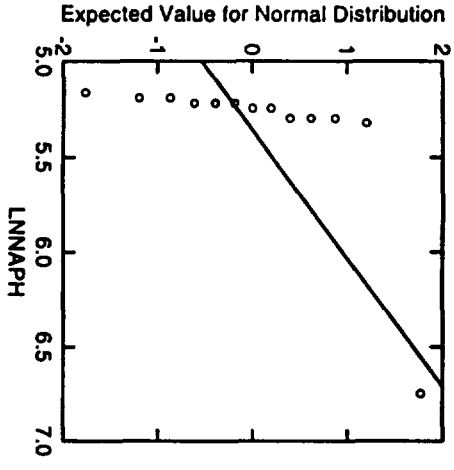
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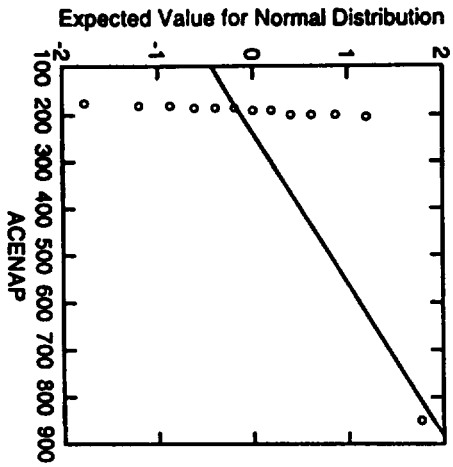
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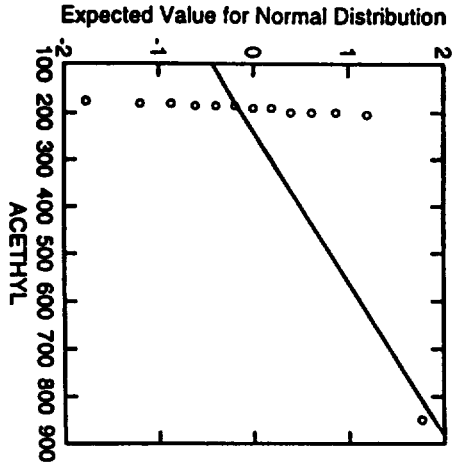
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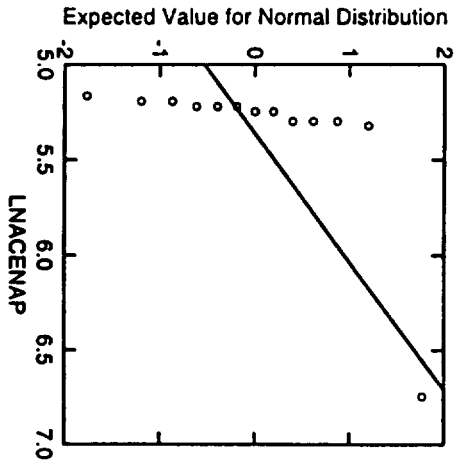
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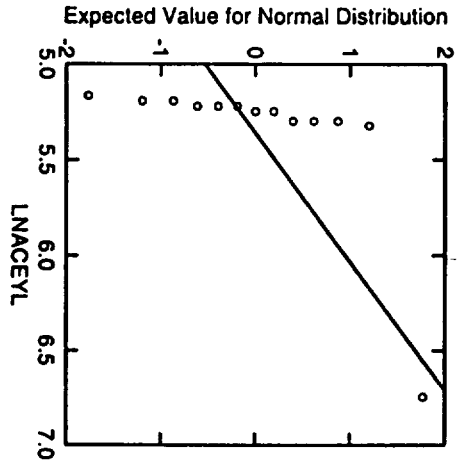
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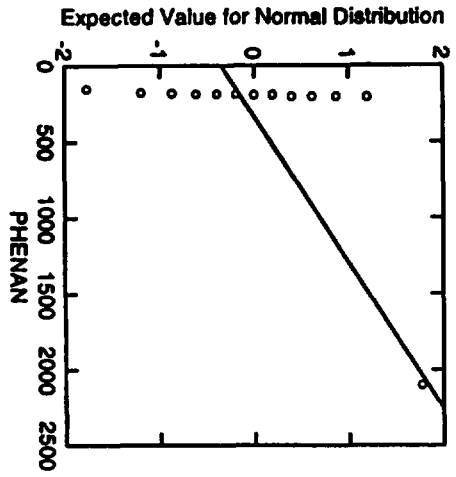
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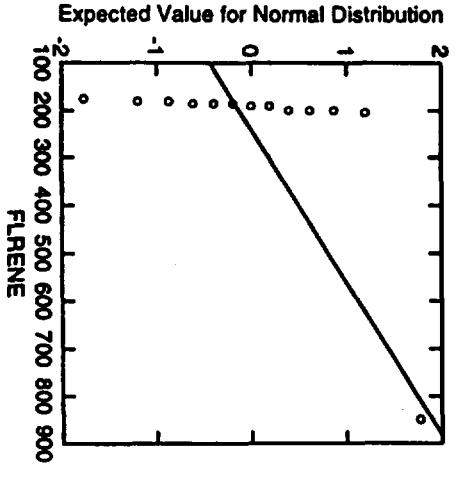
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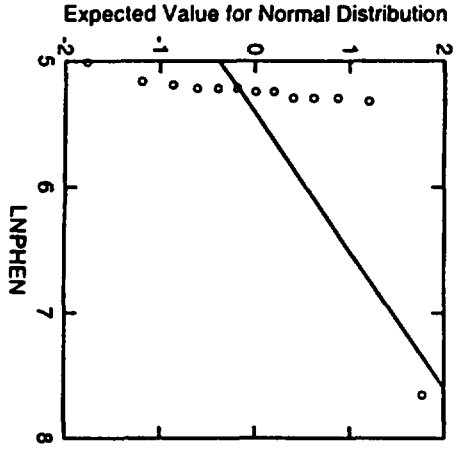
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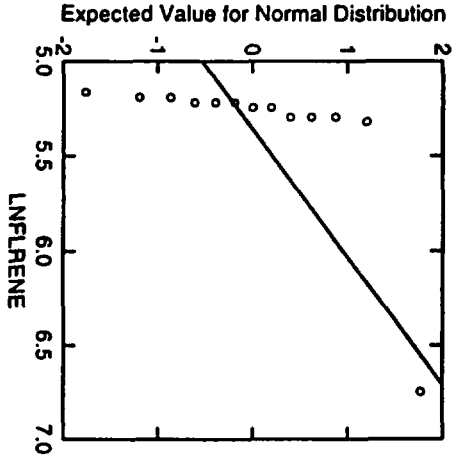
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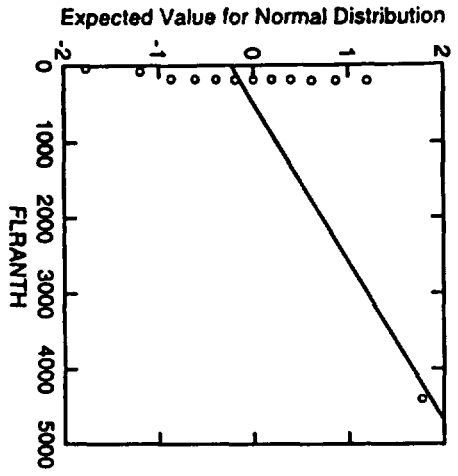
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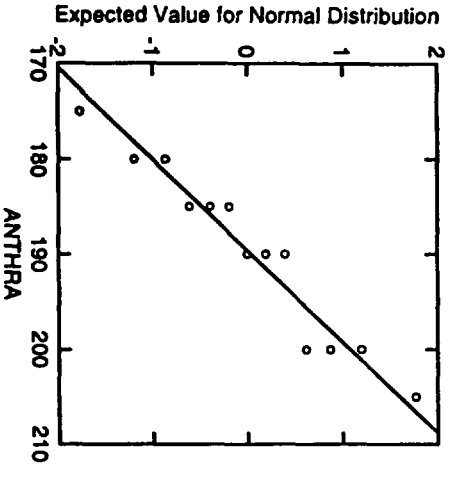
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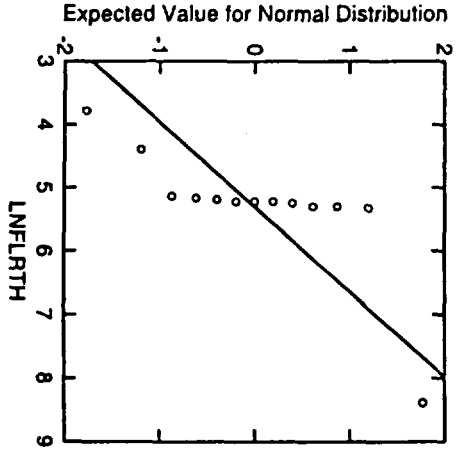
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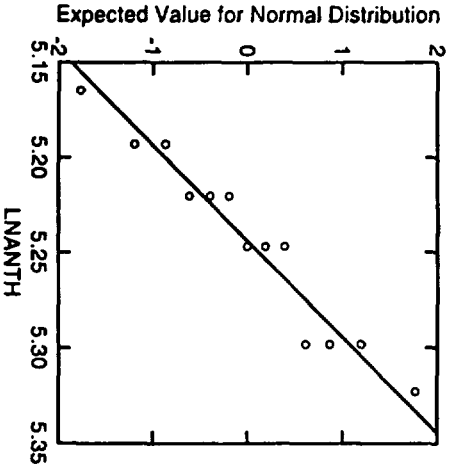
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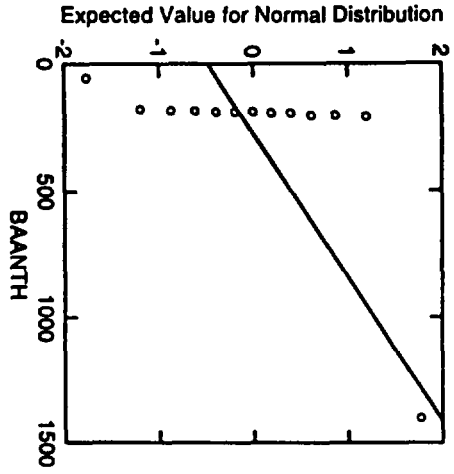
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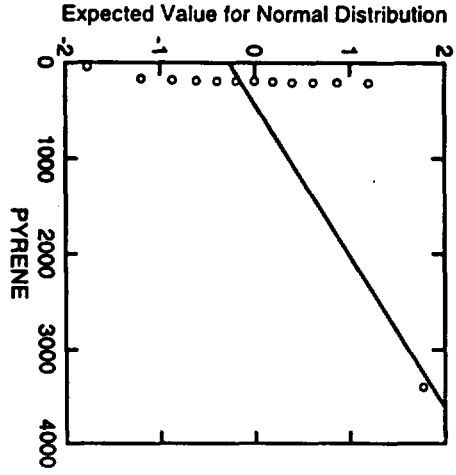
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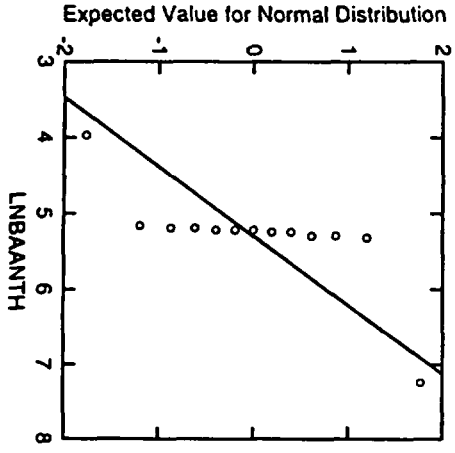
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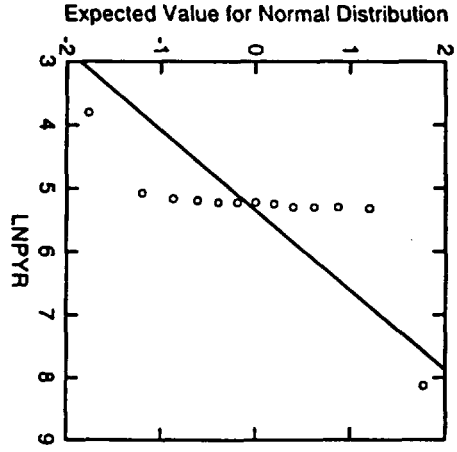
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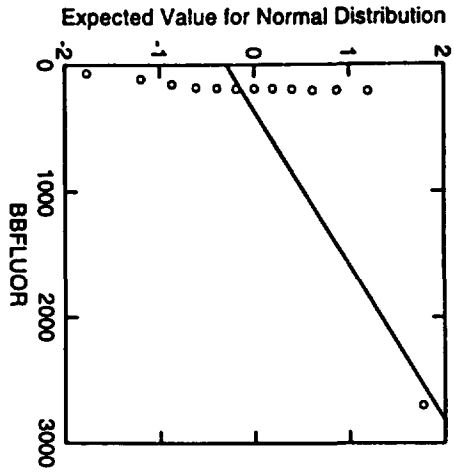
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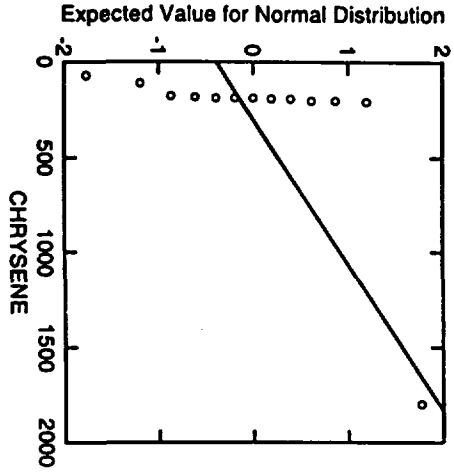
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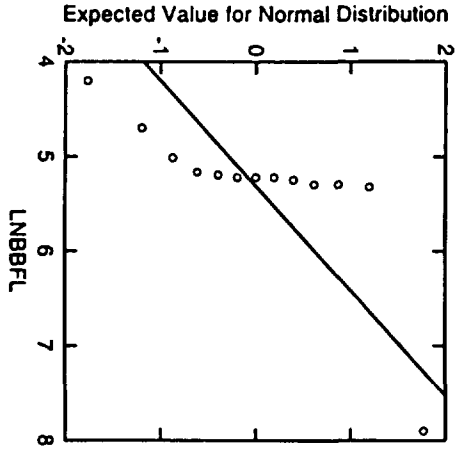
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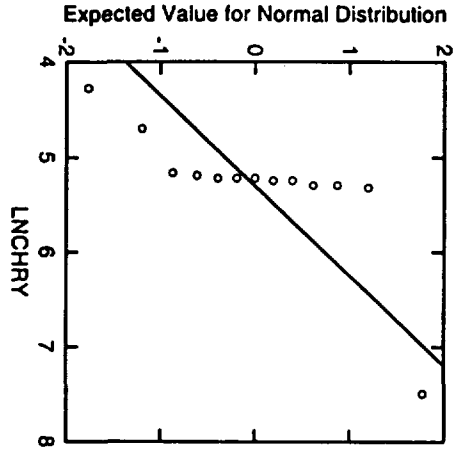
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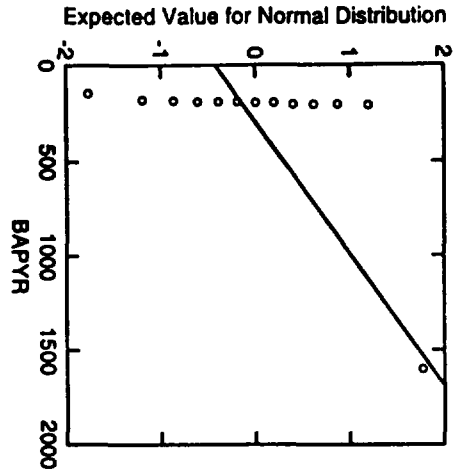
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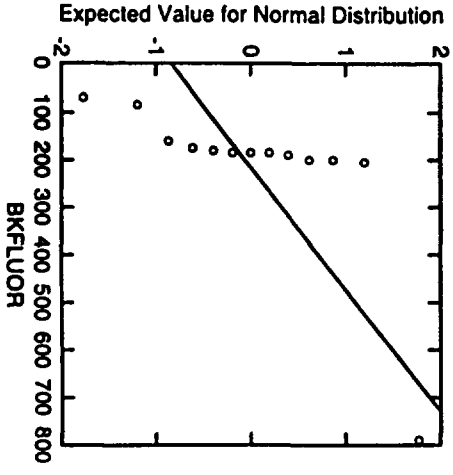
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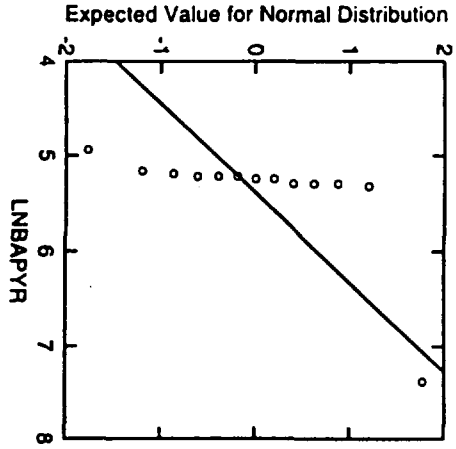
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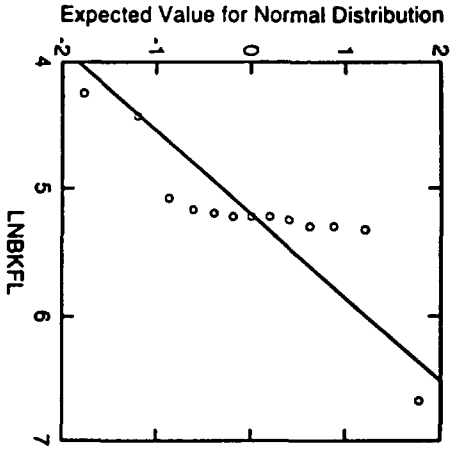
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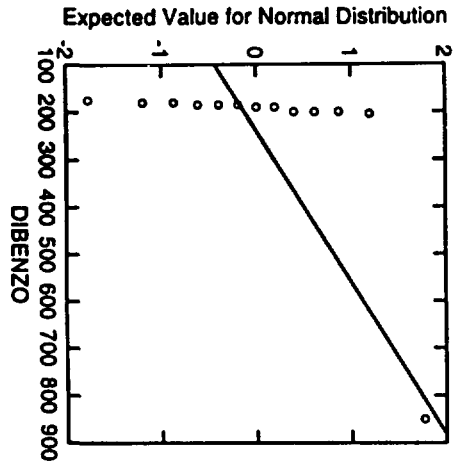
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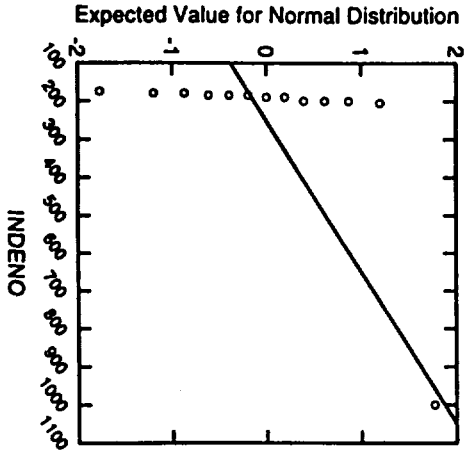
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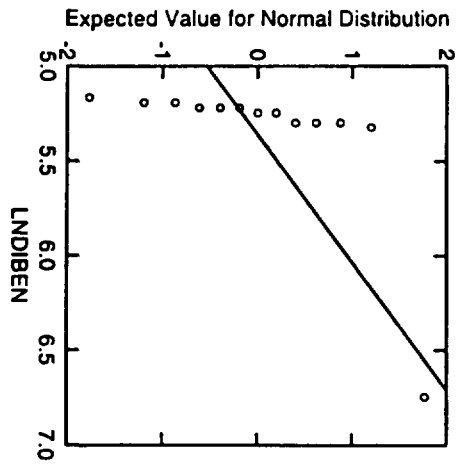
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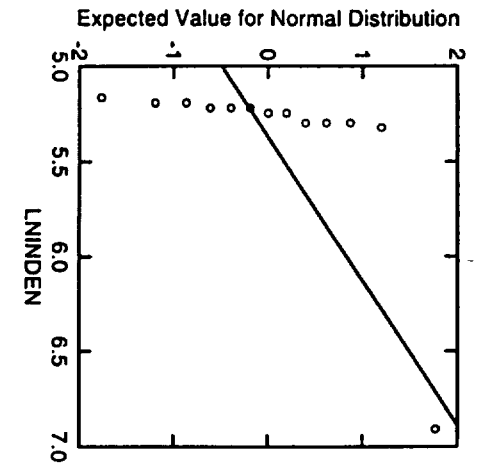
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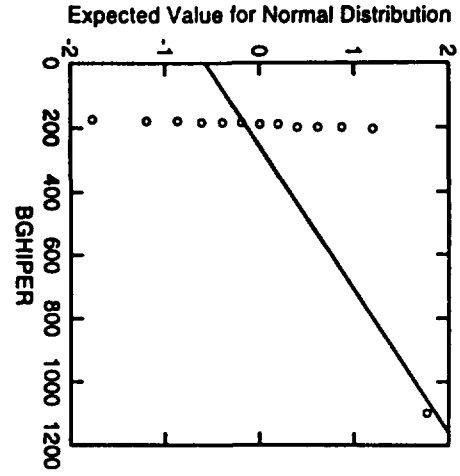
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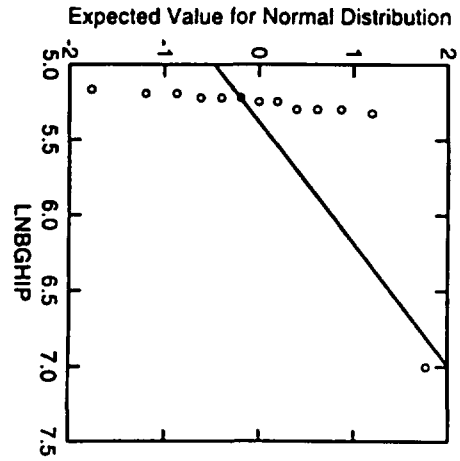
BGHIPER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5.0
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6.5
7.0
7.5
LNBGHIP

APPENDIX E

RBCA EQUATIONS

Equations for the Soil Component of the Groundwater Ingestion Exposure Route	Remediation Objective (mg/kg)	$\frac{GW_{source}}{LF_{sw}}$ NOTE: This equation can only be used to model contaminant migration not in the water bearing unit.	R12
	Groundwater at the source, GW_{source} (mg/L)	$GW_{source} = \frac{GW_{comp}}{C_{(x)}/C_{source}}$	R13
	Leaching Factor, LF_{sw} $(mg/L_{water})/(mg/kg_{soil})$	$LF_{sw} = \frac{\rho_s \bullet \frac{cm^3 \cdot kg}{L \cdot g}}{\left[\theta_{ws} + (k_s \bullet \rho_s) + (H' \bullet \theta_{as})\right] \bullet \left[1 + \frac{(U_{gw} \bullet \delta_{gw})}{(I \bullet W)}\right]}$	R14
	Steady-State Attenuation Along the Centerline of a Dissolved Plume, $C_{(x)}/C_{source}$	$C_{(x)}/C_{source} = \exp\left[\left(\frac{X}{2\alpha_x}\right)\left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$ NOTE: 1. This equation does not predict the contaminant flow within bedrock. 2. If the value of the First Order Degradation Constant (λ) is not readily available, then set $\lambda = 0$.	R15
	Longitudinal Dispersivity, α_x (cm)	$\alpha_x = 0.10 \bullet X$	R16

Transverse Dispersivity, α_y (cm)	$\alpha_y = \frac{\alpha_x}{3}$	R17
Vertical Dispersivity, α_z (cm)	$\alpha_z = \frac{\alpha_x}{20}$	R18
Specific Discharge, U (cm/d)	$U = \frac{K \bullet i}{\theta_T}$	R19
Soil-Water Sorption Coefficient, k_s	$k_s = K_{oc} \bullet f_{oc}$	R20
Volumetric Air Content in Vadose Zone Soils, θ_{as} (cm^3_{air}/cm^3_{soil})	$\theta_{as} = \theta_T - \frac{(w \bullet \rho_s)}{\rho_w}$	R21
Volumetric Water Content in Vadose Zone Soils, θ_{ws} (cm^3_{water}/cm^3_{soil})	$\theta_{ws} = \frac{w \bullet \rho_s}{\rho_w}$	R22
Total Soil Porosity, θ_T (cm^3/cm^3_{soil})	$\theta_T = \theta_{as} + \theta_{ws}$	R23

	Groundwater Darcy Velocity, U_{gw} (cm/yr)	$U_{gw} = K \bullet i$	R24
Equations for the Groundwater Ingestion Exposure Route	Remediation Objective for Carcinogenic Contaminants (mg/L)	$\frac{TR \bullet BW \bullet AT_c \bullet 365 \frac{d}{yr}}{SF_o \bullet IR_w \bullet EF \bullet ED}$	R25
	Dissolved Hydrocarbon Concentration along Centerline, $C_{(x)}$ (g/cm^3_{water})	$C_{(x)} = C_{source} \bullet \exp\left[\left(\frac{X}{2\alpha_x}\right) \bullet \left(1 - \sqrt{1 + \frac{4\lambda \bullet \alpha_x}{U}}\right)\right] \bullet erf\left[\frac{S_w}{4 \bullet \sqrt{\alpha_y \bullet X}}\right] \bullet erf\left[\frac{S_d}{2 \bullet \sqrt{\alpha_z \bullet X}}\right]$ NOTE: 1. This equation does not predict the contaminant flow within bedrock. 2. If the value of the First Order Degradation Constant (λ) is not readily available, then set $\lambda = 0$.	R26

APPENDIX A.2

ECOLOGICAL RISK REPORT

Ecological Risk Assessment
Area 7 - Southeast Rockford Source Control Operable Unit

1.0 Introduction

Ecological Risk Assessments (ERAs) evaluate the likelihood that adverse ecological effects may occur or are occurring at a site as a result of exposure to single or multiple chemical stressors. Risks result from contact between ecological receptors and stressors that are of sufficiently long duration and of sufficient intensity to elicit adverse effects. The primary purpose of this screening-level ERA is to identify contaminants in surface water and sediment that can result in adverse effects to present or future ecological receptors.

This ERA is based primarily on a screening-level approach in which measured chemical concentrations in surface water and sediment are compared to relevant effects concentrations. This ERA is intended to provide information that can help establish remedial priorities and serve as a scientific basis for regulatory and remedial actions for the site.

The general approach used to conduct this ERA is based on site-specific information and on recent EPA guidance, primarily *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 1997a), supplemented by *Guidance for Ecological Risk Assessment* (EPA 1998). The EPA (1998, 1997a) and others (e.g., Barnthouse et al. 1986) recognize that methods for conducting ERAs must be site-specific, and guidance for conducting ERAs are therefore not intended to serve as detailed, specific guidance documents. As much as practicable, the methods, recommendations, and terminology of the Superfund guidance (EPA 1997a) are used to conduct this ERA. The organization of this ERA follows the format presented in the 1997 Superfund guidance document, with some modifications made for site-specific considerations and readability. The primary components of this ERA are Problem Formulation, Analysis Phase, and Risk Characterization. Each of these components is presented below.

2.0 Problem Formulation

The Problem Formulation phase of this ERA establishes the goals and describes the scope and focus of the assessment. The problem formulation phase of the ERA can often be summarized by stating testable null hypotheses. Null hypotheses are generally presented as statements that are rejected or accepted based on relevant data and best professional judgment. The hypotheses to be answered in the ERA are presented below.

- *Chemical contaminants are not present in surface water and sediment onsite or adjacent to the site.*

This question is addressed in the Exposure Assessment phase of the ERA.

- *Where present, the concentrations of chemical contaminants are not sufficiently elevated to impair the survival, growth, or reproduction of sensitive ecological receptors.*

This question is addressed in the Effects Assessment phase of the ERA.

- *Known or potential ecological receptors are not sufficiently exposed to chemical contaminants to cause adverse population-level or community-level effects.*

This question is addressed in the Risk Characterization phase of the ERA, where numeric risk estimates are evaluated with respect to ecological significance.

The problem formulation phase of the ERA also considers site-specific regulatory and policy issues and requirements and preliminarily identifies potential stressors and receptors. Important products of the Problem Formulation phase of the ERA are descriptions of potential sources of ecological stress, potential receptors, exposure pathways and the relationship between general remedial action objectives, assessment endpoints, and measurement endpoints. These are discussed in the following sections.

2.1 Contaminants of Potential Concern

This ERA is focused on the potential ecological effects associated with chemical contamination of surface water and sediment. Contaminated groundwater is addressed in the evaluation of surface water. This approach is based on the rationale that groundwater that discharges into surface water is assessed indirectly through the assessment of surface water quality. Surface soils are not evaluated in this screening-level ERA, which is focused on aquatic environments.

Preliminary data screening suggests that the current levels of some chemical constituents in surface water and sediments have potential to adversely affect ecological receptors. This ERA determines whether such effects are likely to be occurring now or in the future. In addition, this ERA assesses the magnitude of actual or predicted effects based on the nature and extent of chemical contamination.

Based on recently collected creek water and sediment data for this site, the chemicals of potential concern (COPCs) for this ERA include pesticides, PCBs, polycyclic aromatic hydrocarbons (PAHs), phthalates, and a limited number of volatile and other (i.e., non-PAH) semi-volatile organic chemicals. Following EPA guidance, chemicals detected in surface (creek) water and creek sediments at greater than five percent frequency of detection are included in the initial screening of COPCs.

Fifteen COPCs are initially identified for creek water, including six volatile organics, three semi-volatile organics, and six pesticides. Nineteen COPCs are identified for creek sediments, including one volatile organic, nine PAHs, eight pesticides, and one PCB (Aroclor 1254). Some of these 19 sediment COPCs are also COPCs for surface water. In total, 29 chemicals are initially identified as COPCs for this ERA, and these are presented in Table 1.

These 29 COPCs are not equal in their potential to cause adverse ecological effects. Some of the chemicals initially identified as COPCs are known to be toxic under certain conditions, while others are initially retained as COPCs simply because the limited number of samples (five maximum) precludes the elimination of any chemical detected. The latter is based on the accepted practice of eliminating chemicals with a frequency of detection less than five percent. With only five samples, even a single detection equates to a frequency of detection of 20

percent. It is therefore expected that some of the initially identified COPCs contribute little or no risk to exposed receptors, while others have greater potential to cause adverse effects. A primary purpose of the ERA is to determine the major contributors to ecological risk at this site.

Table 1
Data Summary - Initial COPCs

Chemical	Frequency of Detection (percent)	Concentration Range (detected samples) ppb
Sediment (ug/kg)		
1,2-dichloropropane	40	2 - 13
4,4'-DDD	100	0.37 - 1.9
4,4'-DDE	80	0.22 - 0.4
Aldrin	20	0.37
Alpha chlordane	100	0.21 - 0.53
Aroclor 1254	80	23 - 56
Benzo(a)anthracene	100	38 - 230
Benzo(a)pyrene	17	54
Benzo(b)fluoranthene	100	94 - 510
Benzo(k)fluoranthene	100	99 - 540
Bis(2-ethylhexyl)phthalate	100	140 - 430
Chrysene	100	44 - 270
Delta BHC	100	0.29 - 1.2
Dieldrin	100	0.21 - 0.38
Endosulfan II	40	0.3 - 0.31
Fluoranthene	100	92 - 590
Methoxychlor	100	0.76 - 4.6
Phenanthrene	80	56 - 240
Pyrene	100	42 - 140
Surface Water (ug/L)		
1,1-dichloroethane	80	13 - 30
1,1-dichloroethene	20	1

Table 1 Data Summary - Initial COPCs		
Chemical	Frequency of Detection (percent)	Concentration Range (detected samples) ppb
1,2-dichloroethene (total)	80	31 - 54
1,1,1-trichloroethane	80	7 - 36
4-nitrophenol	20	2
Alpha BHC	20	0.0012
Chloroethane	20	10
Dieldrin	20	0.00086
Diethylphthalate	20	2
Endosulfan II	40	0.002 - 0.0037
Endrin ketone	60	0.0023 - 0.0024
Endrin aldehyde	40	0.0022 - 0.0026
Gamma BHC (Lindane)	20	0.001
Pyrene	20	2
Trichloroethene	40	1

The data summary table (Table 1) presents media-specific concentration ranges of detected chemicals and frequency of detection for the initial COPCs. The maximum detected values provide the most appropriate "reasonable maximum exposure" information on contaminant concentrations because of limited data quantity. The average concentration would probably better represents the concentration to which ecological receptors are most likely to encounter, but the true average exposure concentration is unlikely to be accurately derived from approximately five samples. This ERA therefor relies on the maximum detected contaminant concentration to estimate risks in the Risk Characterization section of the ERA.

2.2 Chemical Properties of COPCs

The chemical properties of the COPCs identified in Table 1 affect the fate and transport of COPCs in the environment. Table 2, presented below, presents important chemical properties for the major groups of COPCs identified at this site. Each of these properties are discussed below.

Environmental Persistence

Environmental persistence indicates whether a chemical is likely to be long-lasting in the environment or, alternatively, be degraded by natural processes. For example, some highly chlorinated pesticides are not easily degraded, and are considered to be very persistent. Other

less chlorinated compounds can be degraded by biological and other processes (e.g., photolysis) and therefore may not persist in the environment. Also, volatile organic compounds are unlikely to persist in sediments and surface water.

Bioconcentration Potential

Bioconcentration potential indicates whether a chemical is likely to be retained in biological tissues after it is ingested. Retention of chemicals is not in itself an appropriate measurement endpoint unless it is associated with adverse ecological effects. Retention is, however, useful for verifying exposure and for evaluating bioavailability and the potential for food chain/food web effects. Bioconcentration factors (BCFs), usually derived under equilibrium conditions in a laboratory, are often used as screening-level data to evaluate bioaccumulation potential. BCFs are based on the ratio of contaminant concentration in aquatic biota to contaminant concentration in water. Because BCFs are derived under equilibrium conditions and under relatively long exposure durations, they consider both uptake and elimination (depuration) rates. Chemicals with BCFs greater than 300 generally indicate a potential to bioconcentrate (EPA 1991). Chemicals with log BCFs above 3 (BCFs above 1,000) are considered to have significant potential to bioaccumulate (EPA 1992a). For this ERA, available freshwater BCFs for invertebrates and fish that are (1) known to occur on or near the site, (2) have potential to occur there, or (3) are related to local species are used to evaluate bioconcentration potential. Table 3 presents relevant BCFs for the initial COPCs.

Bioavailability

For this ERA, bioavailable chemicals are defined as those that exist in a form that have the ability to cause adverse ecological effects or bioaccumulate. As stated previously, bioaccumulation may not in itself constitute a significant ecological effect, but provides evidence of exposure and potential for causing adverse effects under certain conditions. For example, some lipophilic chemicals are taken up by biota and are stored in fatty tissues with no apparent ill effects. However, under conditions of reduced food quality and/or quantity, such as during winter when only poor quality foods may be available, these fats are metabolized and the contaminants can then cause adverse effects.

Chemical properties (e.g., ionic form) or environmental conditions (e.g., high levels of dissolved and particulate organic carbon) can affect the potential bioavailability and toxicity of many chemicals. The bioavailability and toxicity of such chemicals in surface water can be influenced, for example, by the concentration of dissolved organic carbon, calcium, and magnesium. In addition, sediment organic carbon content, measured as total organic carbon (TOC) apparently affects bioavailability and toxicity of certain chemicals. For some chemicals, chemical form and thus toxicity can change rather rapidly under changing environmental conditions (e.g., fluctuations in pH, temperature, or surface water flow). Seasonal conditions such as snowmelt and rainfall are likely to affect bioavailability of chemical contaminants in surface water. The bioavailability (and potential toxicity) of chemicals with a high affinity for lipids (lipophilic chemicals) or organic carbon is expected to remain fairly stable because these chemicals bind strongly to organic particulate matter. Once taken up, they are likely to be stored predominately in fatty tissues.

Table 2
General Chemical Properties for Initial COPCs by Chemical Class

Chemical or Class of Chemical	Bioaccumulation Potential	Bioavailability and Toxicity	Environmental Persistence
Polycyclic Aromatic Hydrocarbons (PAHs)	Variable, but most animals and microorganisms can metabolize PAHs to products that ultimately experience complete degradation (Eisler 1987). Rapid uptake and rapid metabolism and elimination is expected in most cases.	Toxicity increases with molecular weight (MW) most cases. Low solubility decreases bioavailability of high MW PAHs. Bioavailability in sediments is generally low. Some PAHs are carcinogenic to mammals.	Generally persistent. Primarily degraded by photolysis and microbial degradation. Degradation slow in sediments that are anoxic with little light penetration.
Chlorinated Pesticides/ Herbicides	Variable, but some (e.g., DDT) accumulate to a very high degree in biological tissues. Most are stored in fatty tissues of animals.	Most are highly toxic and readily bioavailable to aquatic and terrestrial biota.	Most chlorinated hydrocarbons are persistent in the environment because they are resistant to degradation. Organochlorines are generally short-lived in water but may persist in soils.
Volatile Organic Compounds (VOCs)	Low bioaccumulation potential.	Generally low toxicity. Some are common laboratory contaminants. Detections in surface media should be viewed with caution due to expected volatilization and generally rapid degradation.	Not persistent. Easily degraded.

Table 3 Freshwater BCFs for Initial COPCs				
Chemical	Log BCF	Source Species (freshwater)	Reference	Bioaccumulation Concern
1,2-dichloropropane	est. 1.3 from log Kow (2.16)	NA	EPA 1988a	NO
1,1-dichloroethane	est. 1.0 from log Kow (1.79)	NA	EPA 1988a	NO
1,1-dichloroethene	est. 0.8 from log Kow (1.48)	NA	EPA 1988a	NO
1,1,1-trichloroethane	est. 1.3 from log Kow (2.07)	NA	EPA 1988a	NO
4,4'-DDD	est. 4.4 from log Kow (6.10)	NA	EPA 1988a and Jones, Suter, Hall 1997	YES
4,4'-DDE	4.71	fathead minnow	EPA 1988a	YES
4-nitrophenol	est. 1.1 from log Kow (1.91)	NA	EPA 1988a	NO
Aldrin	4.28	multiple species	EPA 1980a	YES
Alpha chlordane	est. 4.58 from log Kow (6.00)	NA	EPA 1988a	YES
Alpha BHC	est. <3.0 from gamma BHC	NA	EPA 1988a	NO
Aroclor 1254	est. 4.60 from log Kow (6.47)	NA	EPA 1988a	YES
Benzo(a)anthracene	4.0	*Daphnia pulex*	Eisler 1987	YES
Benzo(a)pyrene	est. 4.7 from log Kow (6.40)	NA	EPA 1988a and 1980b	YES
Benzo(b)fluoranthene	est. 4.8 from log Kow (6.57)	NA	EPA 1988a and 1980a	YES
Benzo(k)fluoranthene	est. 5.1 from log Kow (6.84)	NA	EPA 1988a and 1980b	YES
Chloroethane	est. <1.4 from log Kow (1.43)	NA	EPA 1988a	NO
Chrysene	<3.0	multiple species	Eisler 1987	NO
Delta BHC	est. <3.0 from gamma BHC	NA	EPA 1988a	NO
Dieldrin	est. 3.9 from log Kow (5.37)	NA	EPA 1988a and Jones, Suter, Hall 1997	YES
Diethylphthalate	est. 0.7 from log Kow (1.40)	NA	EPA 1988a	NO
Endosulfan II	est. 2.8 from log Kow (4.10)	NA	EPA 1988a and Jones, Suter, Hall 1997	NO
Endrin ketone	3.28 (est. from endrin)	fathead minnow	EPA 1988a	YES

Table 3 Freshwater BCFs for Initial COPCs				
Chemical	Log BCF	Source Species (freshwater)	Reference	Bioaccumulation Concern
Endrin aldehyde	3.28 (est. from endrin)	fathead minnow	EPA 1988a	YES
Fluoranthene	<3.0	multiple species	Eisler 1987	NO
Gamma BHC (Lindane)	est. 2.67 from log Kow (3.85)	NA	EPA 1988a	NO
Methoxychlor	est. 3.92 from log Kow (4.30)	NA	EPA 1988a	YES
Phenanthrene	<3.0	multiple species	Eisler 1987	NO
Pyrene	3.43	*Daphnia pulex*	Eisler 1987	YES
Trichloroethene	est. 1.23 from log Kow (2.42)	NA	EPA 1988a	No

Significant bioconcentration potential based on log BCF >3.0 (BCF >1,000)

As presented in Table 3, 14 of the 29 initially identified COPCs have significant potential to accumulate in biological tissues. These 14 COPCs are therefore retained for evaluation of the potential to cause adverse food chain/food web effects.

2.3 Potential Receptors

Potential ecological receptors for this study are defined as plants and animals (i.e., macroinvertebrates, fish, amphibians, reptiles, birds, and mammals) that inhabit or use, or have potential to inhabit or use the aquatic, riparian, and terrestrial habitats of the site. Other organisms (e.g., bacteria, protozoans, and fungi) are also recognized as essential components of aquatic and terrestrial ecosystems, but potential impacts to these organisms are not generally assessed in ERAs because adequate ecotoxicological data are unavailable.

For ERA purposes, the study area consists of Area 7 and areas immediately adjacent. Studies were not conducted specifically to evaluate the relative abundance or diversity of plant and animal species resident to or using the site. In general, however, observations of plants and animals onsite are used to support the ERA by evaluating or confirming habitat suitability.

EPA guidance and common ERA practice precludes the need to assess potential risks for each and every species identified onsite. Several species or groups of organisms are therefore selected to serve as representative receptors for a more detailed evaluation of potential risks. The selection of these representative receptors is based on (1) their perceived importance to local ecosystems (e.g., key prey species, abundant organisms), (2) their relationship with media of concern (i.e., sediment and surface water), and (3) the availability of relevant data for

assessing potential risk. Using these criteria, the following groups of organisms serve as ecological receptor groups for the ERA.

- Aquatic Macroinvertebrates
  (e.g., larval midges, mayflies, stoneflies, caddisflies; amphipods; snails; important prey species for many fish; generally abundant; potential for high biomass; sensitive to water quality impairment; large toxicity database)

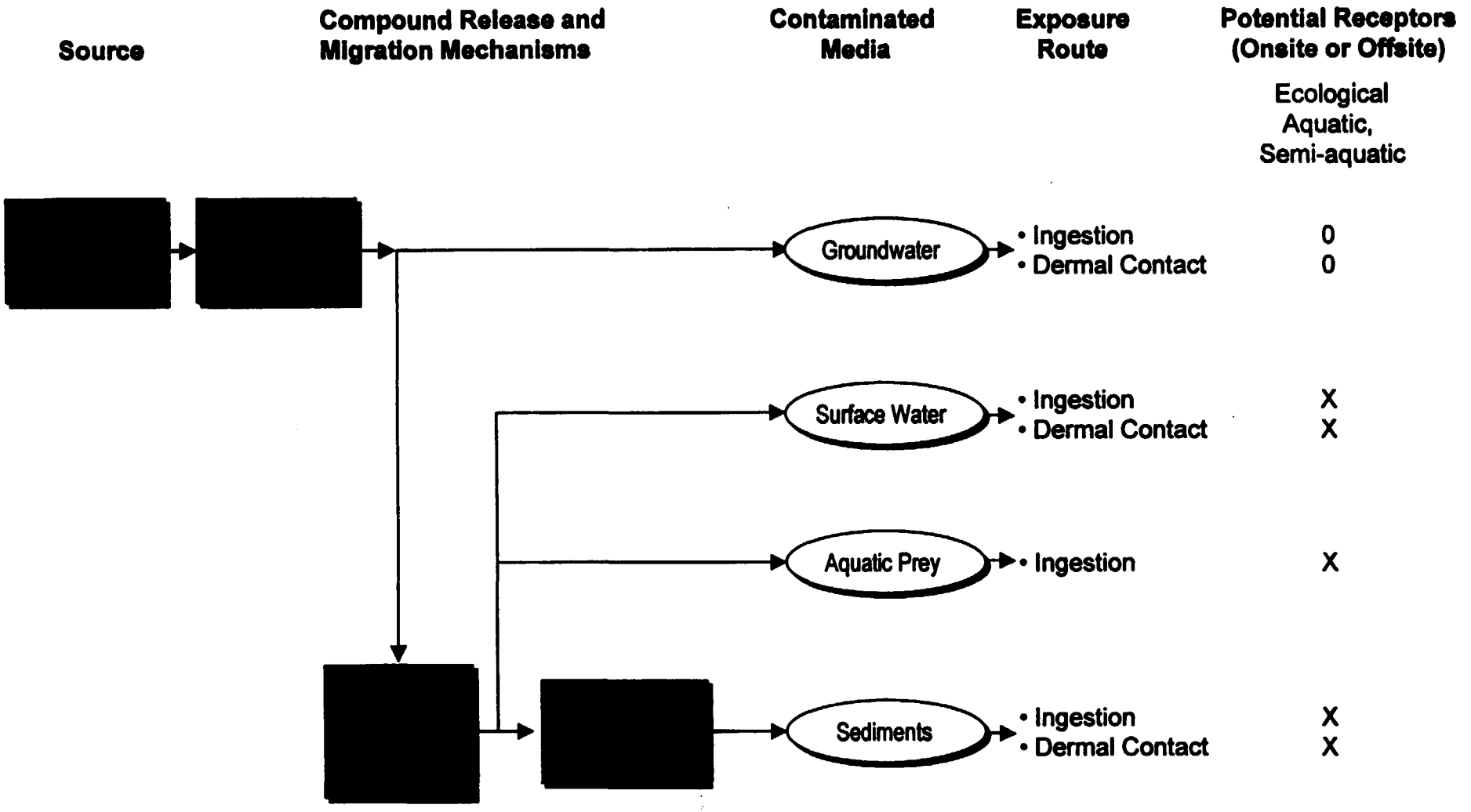
- Freshwater Fish
  (e.g., forage and predator species; potential for high biomass; sensitive to water quality impairment; large toxicity database)

- Piscivorous Birds
  (e.g., belted kingfisher; abundant; protected; preferentially consumes fish that may bioaccumulate contaminants in aquatic environments)

- Top Predators
  (e.g., red fox; at greatest risk for contaminants that bioaccumulate and biomagnify; substantial toxicity data available for closely related dogs)

2.4 Exposure Pathways

Exposure pathways indicate how ecological resources can co-occur or come in contact with hazardous chemicals or materials such as contaminated water and sediments. Descriptions of exposure pathways for ecological receptors are presented in the overall site conceptual exposure model (**Figure 1**). Included in this figure are contaminant sources, fate and transport processes, and exposure routes. Some of the ecological pathways shown in Figure 1 are considered to be relatively minor, and not fully evaluated in this ERA. This ERA is focused on the risks associated with the ingestion of and direct contact with COPCs that migrated into creek sediments and surface water via groundwater inflow or overland flow.



LEGEND

——— Potential Pathway
X Primary Exposure Pathway
O Minor or Unlikely Exposure Pathway

FIGURE 1
SITE CONCEPTUAL EXPOSURE MODEL
AREA 7 CREEK
SOUTHEAST ROCKFORD SCOU

CDM Camp Dresser & McKee

2.5 Assessment and Measurement Endpoints

This section introduces, defines, and discusses appropriate assessment and measurement endpoints for evaluating potential ecological effects.

2.5.1 Assessment Endpoints

Assessment endpoints identify the ecological values to be protected (e.g., abundance and diversity of aquatic macroinvertebrates or fish). Assessment endpoints are directly related to ERA-related remedial action goals and objectives determined for this site. Appropriate assessment endpoints are developed by risk assessors and often consider guidance from relevant regulatory agencies. ERA-related remedial action goals and objectives for this site have not been determined, but are likely to include, for example, the maintenance of a reasonably (given the current constraints) healthy and diverse aquatic ecosystem in the creek adjacent to Area 7. Reasonable site-specific remedial action goals and objectives are assumed and preliminarily used to define appropriate assessment endpoints for this ERA.

Assessment endpoints generally consider ecological relevance, regulatory concerns, societal values, and susceptibility to identified site-specific stressors. For this site, an example of an appropriate assessment endpoints is the abundance and diversity of benthic macroinvertebrates in the creek adjacent to the site. This assessment endpoints is directly or indirectly related to the remedial action goals and objectives assumed for this site. Risk managers may choose to modify remedial action goals and objectives at some time because of concerns (e.g., technological or financial) outside the domain of risk assessment. Assessment endpoints for this ERA are included in Table 4.

2.5.2 Measurement Endpoints

Assessment endpoints are often difficult to measure or evaluate directly. For example, we cannot predict with certainty the critical concentration of a toxicant in surface water and sediment that allows survival and successful reproduction of ecologically important benthic invertebrates in the creek near the site. Such critical concentrations are site-specific and depend on many factors, including the requirements and sensitivities of prey species, chemical interactions (i.e., synergistic, antagonistic, or additive), and the physical and chemical characteristics of the creek (e.g., streambed particle size, sediment organic carbon content, dissolved organic carbon concentration in surface water, temperature, dissolved oxygen, streambank and instream cover, etc.).

Measurement endpoints are used in cases where assessment endpoints cannot be directly measured or evaluated. Measurement endpoints are quantitative expressions of observed or measured biological responses to stressors relevant to selected assessment endpoints. For example, an abundant and diverse macroinvertebrate population (an assessment endpoint) can be evaluated using aquatic toxicity data (measurement endpoints) derived from appropriate laboratory tests. As a specific example, concentrations of dieldrin in creek water can be

compared to dieldrin concentrations laboratory test water that resulted in observed ecologically significant effects to sensitive and relevant test species. For this ERA, ecologically significant effects are defined as those affecting survival, growth, or reproduction. The example described above expresses the relationship between a relevant measurement endpoint (chronic effects concentration of dieldrin in surface water) that is directly related to the assessment endpoints of fish or invertebrate abundance and reproduction. Measurement endpoints selected for this ERA, presented in Table 4, are based on information from appropriate aquatic ecology or toxicology studies or databases (e.g., data summarized in EPA water quality criteria documents).

Table 4
ERA-Related Goals and Objectives - Major Assessment and Measurement Endpoints

Potential Era-related Remedial Action Objectives	Major Assessment Endpoints	Examples of Data Types That May Be Used As Measurement Endpoints
Maintain surface water quality related to COPCs to meet water quality criteria or appropriate risk-based levels	Macroinvertebrate and fish abundance and diversity	Toxicity of COPCs in *surface water* to aquatic macroinvertebrates and fish - based on media-specific, chemical-specific, and receptor-specific toxicity data; comparisons to criteria, standards, and recommended threshold concentrations for surface water
Prevent exposure of aquatic species to instream sediments having chemical contaminant concentrations in excess of risk-based or other relevant levels	Macroinvertebrate and fish abundance and diversity	Toxicity of COPCs in *sediments* to benthic aquatic macroinvertebrates and fish - based on media-specific, chemical-specific, and receptor-specific toxicity data; comparisons to recommended threshold concentrations for aquatic sediments
Prevent exposure of consumers of aquatic and semi-aquatic to prey species having chemical contaminant concentrations in excess of risk-based or other relevant levels	Abundance and diversity of upper trophic level predators	Bioaccumulation potential of COPCs in *sediments and water* to potential prey species - based on comparisons of dose calculations to recommended thresholds to prevent sublethal effects in predator species

3.0 Analysis Phase

This phase of the ERA analyzes exposure data (Exposure Assessment) and effects data (Effects Assessment) for the major chemical stressors and representative receptors previously identified in Problem Formulation.

3.1 Ecological Exposure Assessment

Exposure Assessment summarizes and evaluates available exposure data, including exposure-related data on potential ecological receptors or receptor groups. The primary output of

exposure assessment is an exposure profile that presents the magnitude (e.g., concentration) and distribution (e.g., in surface water and sediment) of stressors to which ecological receptors may be exposed. For this ERA, the primary stressors associated with one or more types of media include volatile organics, phthalates, PAHs, pesticides, and PCBs. Exposure profiles for these stressors serve as input into the final stage of risk assessment, Risk Characterization.

3.1.1 Exposure Profiles

Exposure Profiles describe the magnitude and distribution of stressors identified in the Problem Formulation phase. Exposure concentration data are presented in Table 1, while general exposure information is presented in Tables 5 for the chemical stressors on which this ERA is focused.

Exposure Profiles - Chemical Stressors

Table 1 includes media-specific concentrations for the initial COPCs. Recently collected data considered useable for risk assessment purposes are used to describe the magnitude and distribution of chemical contaminants in the site environment. Although no single concentration value can truly represent the variability of chemical concentrations measured in each media of concern, the upper 95th confidence limit of the arithmetic mean value (U95) probably best represents a reasonable maximum concentration to which receptors may be exposed. Where sufficient data have been collected, the U95 is often used to represent the true mean value. Support for using U95 values is found in recent EPA guidance (1992b) for calculating values that are most representative of actual chemical concentrations in environmental media to which human or ecological receptors may be exposed. This guidance states, however, that calculation of U95 values are appropriate only when sufficient data (i.e., at least 20 to 30 samples) are available. In this particular case, insufficient data have been collected from each individual sampling location to allow appropriate use of U95 calculations--U95 values commonly exceed maximum values where data are limited.

Where chemical concentration data are limited, it is common and accepted practice to use either the arithmetic mean or the maximum detected concentration to represent exposure point concentrations. This ERA uses maximum detected concentration to screen COPCs and to evaluate risks. Although the use of maximums for risk estimation appears conservative, this approach is unlikely to greatly overestimate reasonable maximum exposures because the maximum detected value is based on only a few samples that may not represent the actual range of concentrations to which receptors may be exposed.

Table 5
General Exposure Data for Representative Ecological Receptor Groups

REPRESENTATIVE RECEPTOR GROUP	PRIMARY STRESSOR	PRIMARY POTENTIAL EXPOSURE ROUTES / PROCESSES
Aquatic Macroinvertebrates (e.g., mayfly and midge	Contaminated SW and SED	SW contact and ingestion Ingestion of contaminated prey

Table 5 General Exposure Data for Representative Ecological Receptor Groups		
REPRESENTATIVE RECEPTOR GROUP	PRIMARY STRESSOR	PRIMARY POTENTIAL EXPOSURE ROUTES / PROCESSES
larvae)		SED/pore water contact and ingestion
Freshwater Fish	Contaminated SW and SED	SW contact and ingestion, Ingestion of contaminated prey SED/pore water contact and ingestion
Piscivorous Birds (e.g., belted kingfisher)	Contaminated Prey (primarily fish)	Ingestion of contaminated prey (primarily fish)
Top Predators (e.g., red fox)	Contaminated Invertebrate/ Vertebrate Prey	Ingestion of contaminated aquatic, semi-aquatic, and terrestrial prey

SW = Surface Water
SED = Sediment

Exposure Profiles - Potential Ecological Receptors

Exposure-related information for each of the representative groups of organisms previously identified as potential receptors for this ERA are described in this section. These descriptions are based on likely exposure scenarios preliminarily identified in the Problem Formulation phase of the ERA. These preliminary exposure scenarios are refined here for the major representative receptor groups previously identified. The receptor groups represent species or other taxa with reasonable potential to be exposed to site-related stressors. Exposure scenarios are simplified descriptions of how potential receptors or representative receptor groups may come in contact with previously identified stressors.

Major exposure pathways for many organisms include direct contact with and ingestion of contaminated media and/or prey. Consumption of contaminated prey is generally estimated using daily intake rates for representative animals. Such rates are most appropriately calculated using site-specific data (e.g., contaminant concentrations in food items and dietary composition). Site-specific input parameters for deriving daily intake rates for terrestrial animals are, however, unavailable for this ERA. Critical dietary threshold values for terrestrial wildlife species are therefore used to evaluate dietary exposures in this ERA, and these values are based on appropriate literature values, such as those presented in EPA's Wildlife Exposure Factors Handbook (1993) and in EPA toxicity databases. Exposure scenarios for representative aquatic and semi-aquatic animals, piscivorous birds, and upper trophic level terrestrial predators are discussed below.

3.1.2 Exposure Scenarios

Although several potential exposure scenarios can be identified for ecological receptors, it is most appropriate to focus the assessment on critical exposure scenarios or those most likely to contribute to risk. This ERA is focused on the most critical exposure scenarios identified in the site conceptual model. For example, the air pathway (i.e., inhalation of potentially contaminated

air) is rarely considered significant for ecological receptors, and ecotoxicity data based on inhalation are unavailable. This pathway is therefore not usually assessed in an ERA. Critical exposure scenarios identified for this ERA are discussed below.

Aquatic Exposures

The primary site-related risks for aquatic organisms are likely to be from direct contact with and ingestion of contaminated surface water if and where surface water COPC concentrations are elevated. In addition, ingestion of sediment and sediment pore (interstitial) water with elevated COPCs poses risks to benthic and to a lesser extent water-column biota where such media are contaminated. In addition, aquatic organisms that occupy upper trophic levels (e.g., predatory fish) can be adversely affected by ingesting prey that have accumulated contaminants. This is of most concern for chemicals that readily bioaccumulate, such as 4,4'-DDD, 4,4'-DDE, Aroclor 1254, etc. The relative contribution from each exposure media type (surface water, sediment, interstitial water, and prey) to overall aquatic exposure cannot, however, be reliably determined for most aquatic organisms because data describing the variability in factors that can affect total exposure are lacking. These factors can include intraspecific and interspecific differences in life stage, season, diet, ingestion rate, specific habitat, etc.
This assessment evaluates risks to aquatic biota by comparing recently measured COPC concentrations in surface water and sediments to media-specific criteria, such as chronic ambient water quality criteria (AWQC) and No Observed Adverse Effects Concentrations (NOAECs) derived experimentally or estimated from other critical effects concentrations (e.g., Lowest Observed Adverse Effects Concentrations or LOAECs) for appropriate species. Effects data are discussed in a following section.

Terrestrial Exposures

This ERA is focused on chemical contaminants in surface water, sediments, and potentially on aquatic and semi-aquatic biota that may have accumulated COPCs. Terrestrial exposures of concern are therefore limited to those associated with food chains/food webs that include aquatic and semi-aquatic biota. Terrestrial consumers of aquatic and semi-aquatic biota (e.g., piscivorous birds, omnivorous predatory mammals) therefore serve as the primary focus with regard to terrestrial exposures at this site. Such exposures are discussed below.

Exposures Via Food Chain Transfer

Certain chemicals that readily bioaccumulate differ in the likelihood and severity of adverse effects and in exposure duration based on environmental persistence. Some of the COPCs detected onsite are known to bioaccumulate following ingestion of contaminated surface water, sediment, or prey. Bioconcentration factors (BCFs) or bioaccumulation factors (BAFs) are often used to evaluate bioaccumulation potential. As stated previously, chemicals with BCFs less 300 are considered to have low bioaccumulation potential, while those with BCF between 300 and 1,000 have moderate potential to bioaccumulate. Chemicals with BCFs greater than 1,000 are of most concern with regard to potential bioaccumulation. Table 3 lists freshwater BCFs for the primary COPCs detected onsite that are expected to bioaccumulate.

Fourteen COPCs are identified as having significant potential to bioaccumulate, based on (1) the screening level assessment of experimentally derived bioconcentration factors (BCFs) greater than 1,000 (log BCF >3.0) or (2) estimated bioaccumulation potential based on log octanol/water partition coefficient (Kow). The latter estimated BCFs are based on structure activity relationships derived by Veith and Kosian (1982), presented in EPA 1988a. The COPCs with the reasonable potential to bioaccumulate include the following:

4,4'-DDD	Benzo(a)pyrene	Methoxychlor
4,4'-DDE	Benzo(b)fluoranthene	Pyrene
Aldrin	Benzo(k)fluoranthene	
Alpha chlordane	Dieldrin	
Aroclor 1254		
	Endrin ketone	
Benzo(a)anthracene	Endrin aldehyde	

Some of these chemicals are known to biomagnify (i.e., accumulate to increasingly higher concentrations in upper trophic level receptors). Organisms at the top of food webs/food chains are at most risk from chemicals that biomagnify, such as 4,4'-DDE and 4,4-DDD. Biomagnification of endrin ketone/aldehyde is not as well documented. The BCFs for these chemicals suggest, however, that bioaccumulation is likely. Limited data on methoxychlor suggests that this chlorinated pesticide is less likely to bioaccumulate than other chlorinated pesticides (EPA 1986).

Several high molecular weight PAHs are initially included in the list of COPCs with reasonable potential to bioaccumulate. However, many vertebrates possess enzymes that metabolize PAHs, and bioaccumulation is therefore lower in these organisms than predicted by Kow. Some invertebrates can also metabolize PAHs, while others cannot (Eisler 1987). Compared to PCBs and certain pesticides, PAHs are considered to have relatively lower potential for bioaccumulation because of rapid metabolism by many ecological receptors.

Risks to upper trophic level organisms are therefore expected to be greatest from the COPCs with the greatest potential to bioaccumulate and potentially biomagnify (4,4-DDD, 4,4-DDE, aldrin, alpha chlordane, Aroclor 1254, dieldrin, endrin ketone, and endrin aldehyde). These eight COPCs are evaluated in later sections for food chain/food web effects from bioaccumulation.

3.1.3 Exposure Analysis

Information on distributions of stressors and relevant receptors are combined and summarized in this section, and potential for exposure is discussed. For identified receptors or representative groups of receptors, estimates of potential exposure consider the important ecological parameters that can potentiate or modify exposure, such as habitat use and foraging behavior. Exposure-related information for representative receptors are summarized below.

TOP PREDATORS

Red Fox (*Vulpes vulpes*)

Red fox prefer habitats that provide both adequate cover and prey. The most suitable habitats for red fox are fallow fields, cultivated fields, meadows, bushy fence lines, woody streams, and low shrub cover adjacent to woodlands or water bodies (Baker 1983). Many of these habitats are available on or near the site. Red fox construct burrows which are used as refuges and for rearing young. The burrows are usually located in a well-drained area, however, red fox may sometimes construct dens on river islands (Arnold 1956). These burrows may extend ten to 30 feet below the ground surface (Baker 1983). Red fox are highly mobile, and forage extensively when food is limited. The home range is dependent on topography, vegetation, and prey availability (Baker 1983). Typically, a home range area will be comprised of an adult pair, their offspring, and occasionally a stray adult. The home range of red fox varies seasonally and by gender. For adult males the annual average home range is about 700 hectares, while females average only 96 hectares (EPA 1993). Red fox are nocturnal, and are active eight to 10 hours per 24 hour day. Eighty percent of this time is spent traveling. Red fox are also capable of swimming, which allow utilization of streams and rivers for food sources. In addition, red fox are burrowing animals and therefore spend much of their time digging. Whether red fox can detect and thus avoid chemical contaminants in surface soils or sediments is unknown. Red fox are omnivores, but about 90 percent of the diet is of animal origin. The year-around average diet of red fox in Missouri comprises about five percent plants, five percent invertebrates, 50 percent mammals, 25 percent birds, and 15 percent mixed carrion and other unspecified prey (EPA 1993).

PISCIVOROUS BIRD

Belted Kingfisher (*Ceryle alcyon*)
The belted kingfisher is medium-sized bird that eats primarily fish. Kingfishers typically are found along rivers and streams where streamside vegetation is fairly open, allowing an unobstructed view of the water. Kingfishers prefer to forage in clear waters and avoid those that are turbid, feeding primarily on fish that swim near the surface in shallow water (EPA 1993). This species breeds over most of North America, and winters in most regions of the continental U.S. (EPA 1993). During the coldest months, northern kingfishers migrate to southern regions.
Foraging territory varies with season and food availability. In general, foraging territories range from about one to two kilometers, shoreline length. From two to six pairs of kingfishers per 10 km of river shoreline have been recorded (EPA 1993).

AQUATIC PLANTS, MACROINVERTEBRATES, FISH

Most aquatic biota are continuously exposed to chemicals dissolved in surface water. They may be additionally exposed to chemicals dissolved in sediment interstitial or pore water and to chemicals bound to sediment particles. Fish are most at risk via ingestion of dissolved chemicals and to a lesser extent from ingestion of contaminated sediment (incidental) and prey. Prey ingestion is most critical for chemicals that bioconcentrate to a great degree, such as 4,4'-DDD and Aroclor 1254. Aquatic invertebrates can be similarly exposed, and some filter-feeders such as freshwater clams and mussels are known to bioaccumulate some chemicals very rapidly and to high concentrations. PAHs can concentrate to a high degree in some filter feeding organisms because many do not possess the enzymes that enable them to detoxify

and metabolize PAHs. In contrast, many fish and other vertebrates can detoxify and metabolize PAHs to varying degrees. Aquatic macrophytes can take up dissolved chemicals via root systems, and some single-celled algae can bind chemicals onto the cell surface without taking the chemical into the cell.

3.1.4 Uncertainty Evaluation - Exposure Assessment

All exposure assessments have a degree of uncertainty due to necessary simplifications and assumptions which must be made as part of the evaluation. Major sources of uncertainty in the exposure assessment include the values used to represent the magnitude and distribution of media-specific contamination. Obviously, all media cannot be sampled at all locations, and data interpolation and/or extrapolation is necessary. It is believed, however, that sufficient samples have been collected and appropriately analyzed to adequately describe the nature and extent of chemical contamination at this site. The use of maximum detected COPC concentrations because of the relatively small number of samples collected minimize the chance that exposure concentrations are underestimated in this ERA. On the other hand, exposure concentrations are unlikely to be significantly over-estimated because the maximum detected concentration, based on a few samples, is unlikely to represent the actual maximum exposure concentration to which ecological receptors may be exposed.

3.2 Ecological Effects Assessment

Effects Assessment includes an evaluation of data sources and data types, and presents media-specific and stressor-specific ecological effects concentrations for the COPCs identified for this site. These data serve as major components of stressor-response profiles, which describe the relationship between ecological stressors and effects.

3.2.1 Evaluation of Effects Data

This section of the ERA describes and provides support for the sources and types of effects data (e.g., toxicity data) selected for use in the ERA. Data sources and types are described on a media-specific basis. Selected measurement endpoints or effects data are based on relevance to the COPCs and receptors identified for this site. These data are directly applicable to the previously identified assessment endpoints and to likely remedial action objectives for this site. Some effects data are more relevant and useful than others. For example, effects data are unavailable for certain COPCs or types of receptors associated with this site. In these cases, the effects assessment is based on more general effects data available in the literature. The use of non-specific or surrogate effects data increases the uncertainties in risk estimates based on these data. Finally, site-specific bioaccumulation and toxicity data are unavailable for this ERA. The effects assessment uses a weight-of-evidence approach where multiple data sources are used to evaluate the most appropriate effects concentrations for estimating risk. Effects concentrations that are substantially lower or higher than the majority of the available data are not used because of the uncertainties associated with such data. This weight-of-evidence approach is especially important where relevant site-specific data are lacking. The availability of relevant and useful effects data is media specific, and effects data sources for each media of concern are presented below.

EFFECTS DATA SOURCES

Surface Water

Acceptable and relevant effects data for many site-related COPCs detected in surface water are available. The sources of such data are listed below. Most of the surface water toxicity data used in this ERA are from Quality Criteria for Water (EPA 1986) and chemical-specific Ambient Water Quality Criteria Documents developed by EPA. Also used are Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review (Eisler 1987), and Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision (Suter and Tsao 1996).

Acute AWQC derived by EPA are used to assess potential for severe effects, based on mortality endpoints and short-duration toxicity tests. Chronic AWQC are used to evaluate potential for sublethal effects based on growth and reproduction endpoints and longer duration exposures. AWQC are intended to protect 95 percent of aquatic species 99 percent of the time. Therefore, maintaining exposure concentrations of contaminants below chronic AWQC should protect most species most of the time. Chronic AWQC are therefore the preferred type of effects data for surface water COPCs. Eisler (1987) summarizes available ecotoxicity data for several important PAH contaminants for both aquatic and terrestrial species. Finally, Suter and Tsao (1996) provide probably the most comprehensive summary of chemical-specific ecotoxicological data for aquatic receptors.

Table 6 identifies specific data sources and selected measurement endpoints or effects data from these sources, with adjustments as necessary to estimate safe concentrations or concentrations at which adverse effects are unlikely for most species. This concentration is commonly defined as the No Observed Adverse Effects Concentration or NOAEC. Where surface water effects values are based on the lowest observed adverse effect concentration or LOAEC for a particular species, these data are divided by 10 to estimate the NOAEC (LOAEC / 10 = NOAEC). This provides a level of safety for other non-tested species. Where effects values are based on sublethal effects to the most sensitive species within a multi-species database (e.g., AWQC or secondary chronic values), these data are not further adjusted or divided. In these cases, the criterion or secondary chronic value is considered a threshold that, if not exceeded, will protect most species most of the time. This is implied in the derivation of AWQC, and there is no reason to apply additional safety factors to AWQC or secondary chronic values if one assumes these values to be adequately protective of populations and communities. The final effects values based on NOAECs or appropriate surrogates protective of communities and populations (e.g., AWQC) are compared to exposure concentrations of COPCs detected in site surface water to estimate risks.

Effects Data Sources (Sediment)

Universally-accepted biological effects concentrations for most sediment contaminants have not been developed for ecological receptors. In general, the most useful data on potential sediment toxicity is obtained from site-specific studies using site sediments and resident or representative

species. Site-specific sediment toxicity data are, however, unavailable for this ERA. The evaluation of the potential toxicity associated with COPC contamination of onsite sediments is based on the comparison of COPC concentrations in site area sediments to relevant data from various sources. These sources include EPA sediment criteria, EPA-recommended or proposed sediment thresholds, and site-specific sediment concentrations based on the equilibrium partitioning (EP) approach recommended by EPA (Jones, Suter, and Hall 1997). The EP approach uses literature-based input parameters (e.g., sediment/water partition coefficients or Kps) and site-specific COPC concentrations in sediment. Other useful sediment effects concentrations are available from Long and Morgan (1991) and Persaud et al. (1993). Jones, Suter, and Hull (1997) presents a summary of relevant and useful ecotoxicity data for sediment contaminants, and they include data from EPA, Long and Morgan, Persaud et al., and others. This document provides the primary source of sediment toxicity data for this ERA.

Databases such as that of Long and Morgan (1991) have been established that describe the co-occurrence of chemical contaminants and apparent biological effects, and others (e.g., Persaud et al. 1993) include interim criteria for contaminants in sediment. Although the data presented in these more general databases are associated with certain limitations and uncertainties, they can contribute useful information to the overall evaluation of potential sediment toxicity using a weight-of-evidence approach. Such an approach is used in the selection of appropriate effects concentrations for COPCs in sediment.

Table 6 includes selected measurement endpoint data or effects data for creek sediments based on these data sources. Again, data based on single species LOAECs or similar values are adjusted to estimate safe or no effects concentrations based on estimated NOAECs. As for surface water effects values, sediment effects values based on sublethal effects in the most sensitive species within a multi-species database are not further adjusted. These data (e.g., low effect thresholds or values based on AWQC and EP) are considered protective of most species most of the time without further adjustment.

3.2.2 Stressor-Response Profiles

Chemical Stressors

Stressor-response profiles for chemical stressors (Table 6) present critical effects data for relevant ecological receptors or appropriate surrogate species that may be exposed to COPCs at this site. These profiles include information on the lethal and sublethal effects that may be exhibited by exposed organisms correlated to media-specific threshold concentrations of the COPCs.

There is not equal confidence in or universal acceptability of the effects concentrations presented in Table 6. Sources of ecological effects data were ranked for useability in the ERA. Data were taken from a second or third ranked source only if primary data sources were incomplete for a particular COPC. Sources or types of surface water effects concentrations used in Table 6 are listed below, in order of preference.

- EPA chronic national ambient water quality criterion (EPA)

(Assumes protection of 95% of aquatic species 99% of the time)

- Secondary chronic value derived by Suter and Tsao (1996)
  (Serves as surrogate for AWQC, and assumes similar level of protection)

- Estimated NOAEC based on LC_{50} estimated from chemical structure/activity relationships (SARs) presented in EPA 1988a.
  (LC_{50}/10 estimates LC_1 or effects threshold; effects threshold/10 estimates NOAEC)

Sources or types of sediment effects concentrations presented in Table 6 are listed below, in order of preference.

Organic COPCs in Sediment

- EPA chronic sediment criteria or proposed or recommended sediment threshold concentrations

- Sediment effects concentrations based on equilibrium partitioning (EqP) approach as recommended by EPA
  (these values are based on water quality benchmarks (e.g., EPA AWQC, secondary chronic values, or estimated NOAECs), log octonal/water partition coefficients (log Kow), and an assumed site total organic carbon (TOC) concentration of 1%)

- Low Effects Level (LEL) derived by the Ontario Ministry of the Environment for freshwater sediments (Persaud et al. 1993 in Jones, Suter, and Hall 1997)

- Threshold effects concentration derived by the Florida Department of Environmental Protection for marine and estuarine sediments (in Jones, Suter, and Hall 1997)
  (used for chrysene and pyrene only; assumes that toxicity in freshwater is not significantly different than that of saltwater or estuarine environments)

Table 6
Selected Effects Concentrations for COPCs in Surface Water and Sediment

Chemical	Exposure Media	Effects Concentration / Effects Description	Reference
1,2-dichloropropane	SED	701 ug/kg based on estimated aquatic LC50 (43,000 ug/L) / 100 to estimate NOAEC (430 ug/L) and EqP (log Kow=2.25, TOC=1%)	EPA 1988a and Jones, Suter, and Hall 1997
1,1-dichloroethane	SW	47 ug/L secondary chronic value	Suter and Tsao 1996
1,2-dichloroethene (total)	SW	590 ug/L secondary chronic value	Suter and Tsao 1996

Table 6 Selected Effects Concentrations for COPCs in Surface Water and Sediment			
Chemical	Exposure Media	Effects Concentration / Effects Description	Reference
1,1-dichloroethene	SW	25 ug/L secondary chronic value	Suter and Tsao 1996
1,1,1-trichloroethane	SW	11 ug/L secondary chronic value	Suter and Tsao 1996
4,4'-DDD	SED	110 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
4,4'-DDE	SED	110 ug/kg based on secondary chronic value for 4,4'-DDD	Jones, Suter, and Hall 1997
4-nitrophenol	SW	300 ug/L secondary chronic value	Suter and Tsao 1996
Aldrin	SED	2 ug/kg Ontario MOE LEL	Jones, Suter, and Hall 1997
Alpha BHC	SW	2.2 ug/L secondary chronic value	Suter and Tsao 1996
Alpha chlordane	SED	2800 ug/kg EPA chronic criterion	Jones, Suter, and Hall 1997
Aroclor 1254	SED	810 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Benzo(a)anthracene	SED	110 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Benzo(a)pyrene	SED	140 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Benzo(b)fluoranthene	SED	6200 ug/kg based on secondary chronic sediment benchmark of 6200 ug/kg for fluoranthene	Jones, Suter, and Hall 1997
Benzo(k)fluoranthene	SED	6200 ug/kg based on secondary chronic sediment benchmark of 6200 ug/kg for fluoranthene	Jones, Suter, and Hall 1997
Bis(2-ethylhexyl)phthalate	SED	890,000 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Chloroethane	SW	1630 ug/L estimated from M.W. (64.5), log Kow (1.43), based on 96-hr fish LC50 /100 to estimate NOAEC	EPA 1988a
Chrysene	SED	108 ug/kg based on threshold effects level from Florida Department of Environmental Protection	Jones, Suter, and Hall 1997
Delta BHC	SED	120 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Dieldrin	SW SED	0.062 ug/L EPA chronic criterion 110 ug/kg EPA proposed sediment quality criterion	Suter and Tsao 1996 Jones, Suter, and Hall 1997
Diethylphthalate	SW	210 ug/L secondary chronic value	Suter and Tsao 1996

Table 6 Selected Effects Concentrations for COPCs in Surface Water and Sediment			
Chemical	Exposure Media	Effects Concentration / Effects Description	Reference
Endosulfan II	SW SED	0.051 ug/L secondary chronic value 5.5 ug/kg secondary chronic value	Suter and Tsao 1996 Jones, Suter, and Hall 1997
Endrin ketone	SW	0.061 ug/L EPA chronic criterion for endrin	Suter and Tsao 1996
Endrin aldehyde	SW	0.061 ug/L EPA chronic criterion for endrin	Suter and Tsao 1996
Fluoranthene	SED	6200 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Gamma BHC (Lindane)	SW	0.08 ug/L EPA chronic criterion	Suter and Tsao 1996
Methoxychlor	SED	19 ug/kg secondary chronic value	Jones, Suter, and Hall 1997
Phenanthrene	SED	1800 ug/kg EPA chronic criterion	Jones, Suter, and Hall 1997
Pyrene	SW SED	3 ug/L estimated from M.W. (202), log Kow (7.66), based on 14-d fish LC50 /100 to estimate NOAEC 153 ug/kg based on threshold effects level from Florida Department of Environmental Protection	EPA 1988a and EPA 1980b Jones, Suter, and Hall 1997
Trichloroethene	SW	47 ug/L secondary chronic value	Suter and Tsao 1996

SW = Surface Water
SED = Sediment (all sediment effects concentrations assume 1% TOC)

3.2.3 Uncertainty Evaluation - Effects Assessment

In this section, the major sources of uncertainty in the effects analysis are identified and their potential impact on the ERA is evaluated. Media-specific toxicity data used in this ERA to describe the potential effects to ecological receptors are probably the primary source of uncertainty in the effects analysis. Extrapolations are often used to relate measurement endpoints (e.g., lethal concentrations or LC_{50} values) to assessment endpoints (e.g., macroinvertebrate abundance) or to relate one measurement endpoint (e.g., LC_{50}) to another (NOAEC). Extrapolations between taxa (e.g., species to species), between chemicals (e.g., based on similar structure), or between responses (e.g., lethal to sublethal) are commonly used where specific data are limited or lacking. The use of these types of extrapolation, however, increase uncertainty in risk assessment. The use of extrapolated data is therefore limited as much as possible in this ERA. In only a few cases are extrapolations between chemicals or responses made. In these cases, where toxicity data are lacking for a particular COPC, toxicity data from similar chemicals were reviewed and the most appropriate value was selected from

those available. Appropriateness was based on relative consistency with values from other sources and on best professional judgement.

Toxicity data that provide the basis for the majority of accepted effects thresholds are based on effects experienced by individual organisms under controlled laboratory conditions. There is therefore concern with the applicability of these data to reflect or predict population-level or community-level effects in the field. Adequate field data are lacking for most chemical stressors and receptor species, and laboratory-based data are therefore used and accepted in most cases to estimate effects in the field. Effects to individuals in the laboratory may or may not be representative of effects that may be seen in populations and communities in the field.

Effects data for surface water and sediment contaminants are considered to be associated with low to moderate uncertainty, respectively. There is considerably more uncertainty in the data used to evaluate the potential toxicity of contaminated sediments because ecotoxicity data for sediments are not as universally accepted or available as are ecotoxicity data for surface water.

The lack of relevant site-specific toxicity data increases uncertainty in this ERA to some degree. However, the availability of (1) site-specific COPC concentrations in multiple exposure media and locations, and (2) relevant and acceptable toxicity data for most COPCs, minimize these uncertainties to where they are unlikely to affect the outcome of the ERA.

Because site-specific effects or biological data are for the most part unavailable, a weight-of-evidence approach is used to assess potential for ecological effects. The weight-of-evidence approach used in this ERA, which relies on ecological effects data from a large variety of appropriate and relevant data sources, decreases the overall uncertainty compared to assessments based on only one or a few data sources.

4.0 Risk Characterization

Risk characterization integrates exposure data (e.g., COPC concentrations in surface water) and effects data (e.g., the maximum concentration of a COPC in laboratory water associated with no adverse effects in exposed organisms) to estimate risks. Risks for ecological receptors are assessed in this ERA on a media-specific basis. There is no appropriate method for combining ecological risks from multiple exposure sources because the relative contribution to total risk from each source (e.g., surface water, sediment, soil, ingested prey) is unknown. Also, the relative risk contribution from each source and for each species probably varies both spatially and temporally, primarily as seasonal migratory and dietary habits change.

4.1 Media-Specific Risks from Chemical Stressors

A large variety of chemical contaminants have been detected in onsite media, and this ERA is focused on assessing the risks from COPC exposures via direct contact with and ingestion of surface water (aquatic receptors) and direct contact with streambed sediment (aquatic receptors). Also of concern for COPCs that readily bioaccumulate is ingestion of contaminated food items. Numeric risk estimates are presented for COPCs in surface water and sediments

based on site-wide data. Data from all locations within a media type are combined, and the maximum values are based on the combined data set.

Risk estimates are based on the ratio of maximum and minimum detected COPC concentrations to selected effects concentrations. These tables therefore depict both reasonable "worst-case" risk estimates based on *maximum* detected COPC concentrations and lower limit risk estimates based on the *minimum* of detected COPC concentrations. Risks actually experienced by exposed local ecological receptors probably range between these two values, but are likely to vary spatially, temporally, and between receptor species. The risk estimates in these tables are listed in order of highest to lowest risk, based on the maximum risk estimates.

Risk estimates based on simple quotients or ratios of a single exposure concentration (e.g., maximum detected) to a single effects concentration (e.g., NOAEC) such as those included in the following tables are best interpreted in the context of "relative risk". That is, the numeric values are in themselves associated with considerable uncertainties, but the relative differences between risk estimates are useful for focusing on the major contributors to ecological risk. Ratios below 1.0 indicate little or no likelihood of adverse effects to exposed receptors, while higher ratios generally suggest greater likelihood of unacceptable risk. Higher risk estimates are not necessarily associated with severity of adverse effects. Potentially significant ecological risks (i.e., those >1.0) are identified in the tables by bold type.

4.1.1 Risks from COPCs in Surface Water (Direct Contact)

Table 7 presents the risk estimates for COPCs detected in surface water. With the exception of 1,1,1-trichloroethane, all ecological COPCs in surface water are associated with maximum risk estimates less than 1.0. The maximum risk estimate for 1,1,1-trichloroethane (3.3) is also of relatively minor concern because (1) the value is based on the *maximum* detected concentration, and (2) the risk estimate only slightly exceeds the 1.0 threshold. COPCs in surface water, with the possible exception of 1,1,1-trichloroethane, are therefore considered to be negligible contributors to potential ecological effects in surface water at the site.

Table 7
Risks from COPCs in Surface Water

COPC	Effects Concentration ug/L	Minimum Det. Conc. ug/L	Maximum Det. Conc. ug/L	Minimum Risk	Maximum Risk
1,1,1-trichloroethane	11	7	36	0.6	3.3
Pyrene	3	2	2.0	0.5	0.9
1,1-dichloroethane	47	23	30	0.5	0.6
1,2-dichloroethene (total)	590	31	54	0.1	0.1
Endosulfan II	0.051	0.002	0.0037	0.0	0.1

Table 7 Risks from COPCs in Surface Water					
COPC	Effects Concentration ug/L	Minimum Det. Conc. ug/L	Maximum Det. Conc. ug/L	Minimum Risk	Maximum Risk
Alpha BHC	2.2	0.0012	0.0012	0.0	0.0
Chloroethane	1630	10	10	0.0	0.0
Dieldrin	0.062	0.00086	0.00086	0.0	0.0
Diethylphthalate	210	2	2	0.0	0.0
4-nitrophenol	300	2	2	0.0	0.0
Endrin ketone	0.061	0.0023	0.0024	0.0	0.0
Endrin aldehyde	0.061	0.0022	0.0026	0.0	0.0
Gamma BHC (Lindane)	0.08	0.001	0.001	0.0	0.0
1,1-dichloroethene	25	1	1	0.0	0.0
Trichloroethene	47	1	1	0.0	0.0

4.1.2 Risks from COPCs in Sediment

Table 8 presents the risk estimates for COPCs detected in sediment. Three of the 19 COPCs detected in sediment are associated with maximum risk estimates greater than the 1.0 threshold. These are benzo(a)anthracene (6.1), methoxychlor (3.4), and chrysene (2.5). Maximum risk estimates for dieldrin (0.9) and pyrene (0.9) both approach but do not exceed the 1.0 threshold for significant risk. None of the COPCs detected in sediment greatly exceed the 1.0 threshold, suggesting relatively low potential for adverse effects from these COPCs. The cumulative risks from the three COPCs with maximum risk estimates greater than 1.0, along with those contributed by dieldrin and pyrene, may be ecologically significant. Assuming additivity, the total risk of all sediment COPCs remains quite low. In general, risk estimates are evaluated as <1.0 indicating no risk, 1.0 to 10 indicating low risk, 10 to 100 indicating moderate risk, and >100 indicating high risk. Maximum risk estimates for all other COPCs in sediment are sufficiently below the 1.0 threshold to suggest little potential for adverse ecological effects.

Table 8 Risks from COPCs in Sediment					
COPC	Effects Concentration ug/kg	Minimum Det. Conc. ug/kg	Maximum Det. Conc. ug/kg	Minimum Risk	Maximum Risk
Benzo(a)anthracene	110	38	230	0.3	6.1

Table 8 Risks from COPCs in Sediment					
COPC	Effects Concentration ug/kg	Minimum Det. Conc. ug/kg	Maximum Det. Conc. ug/kg	Minimum Risk	Maximum Risk
Methoxychlor	19	0.76	64	0.0	3.4
Chrysene	108	44	270	0.4	2.5
Pyrene	153	42	140	0.3	0.9
Dieldrin	110	0.21	0.4	0.5	0.9
Benzo(a)pyrene	140	54	54	0.4	0.4
Aldrin	2	0.37	0.37	0.2	0.2
Aroclor 1254	810	23	56	0.0	0.1
Benzo(b)fluoranthene	6200	94	510	0.0	0.1
Benzo(k)fluoranthene	6200	99	540	0.0	0.1
Phenanthrene	1800	56	240	0.0	0.1
Fluoranthene	6200	92	590	0.0	0.1
Endosulfan II	5.5	0.3	0.31	0.1	0.1
Bis(2-ethylhexyl)phthalate	890,000	140	430	0.0	0.0
Delta BHC	120	0.29	1.2	0.0	0.0
4,4'-DDE	110	0.22	0.4	0.0	0.0
4,4'-DDD	110	0.37	1.9	0.0	0.0
Alpha chlordane	2800	0.21	0.53	0.0	0.0
1,2-dichloropropane	701	2	13	0.0	0.0

4.1.3 Risks from COPCs in Food Items (Ingestion)

As discussed previously, a subset of six ecological COPCs are selected for a more extensive assessment of potential to adversely affect food chains or upper trophic level organisms. These nine COPCs (4,4'-DDD, 4,4'-DDE, aldrin, alpha chlordane, Aroclor 1254, dieldrin, endrin ketone, and endrin aldehyde), have potential to bioaccumulate to a greater degree than other ecological COPCs, based primarily on experimental bioconcentration factors (BCFs). BCFs are a function of chemical structure and characteristics, receptor characteristics, and exposure duration. Most organic COPCs that readily accumulate in biological tissues are lipophilic (attracted to fatty tissues). These COPCs generally do not bioaccumulate in plants to the same degree that they can in the fatty tissues of animals.

Risks to consumers of onsite animal prey from these COPCs will vary significantly depending on receptor species, season, exposure source and location, as well as numerous other factors. Risks to consumers from bioconcentratable COPCs are therefore based on representative species and reasonable worst-case exposure assumptions.

Representative receptors for this analysis are belted kingfisher, representing piscivorous birds, and red fox, a representative top predator. Exposure assumptions are based on EPA guidance and site-specific considerations. EPA and other guidance generally recommend conservative or potentially over-protective assumptions regarding food web models or dose calculations. These conservative assumptions have been incorporated into the analysis presented here. The uncertainties in exposure-related assumptions can be greatly reduced by the inclusion of site-specific biological data such as the concentrations of bioconcentratable COPCs in onsite prey species. Such data are not, however, available for this ERA.

This analysis therefore uses a simple food chain model to estimate the maximum daily dose of bioconcentratable COPCs that representative site receptors may receive. This model is based on the standard dose equations recommended by EPA. The equation used for this analysis is modified from equations recommended by EPA (1993) and is presented below.

$$MDD_{pot} = [Sum\ (C_{food} * DF * NIR_{food}) + (NIR_{water})] * SFF$$

where MDD_{pot} = Maximum Daily Dose (potential) - (mg/kg/d)
C_{food} = COPC Concentration in food item (mg/kg)
DF = Dietary Fraction (0-1.0)
NIR_{food} = Normalized Food Ingestion Rate (kg/kg body wt./d)
NIR_{water} = Normalized Water Ingestion Rate (L/kg body wt./day)
SFF = Site Foraging Frequency (0-1.0)
NIR = Normalized Ingestion Rate
(Ingestion Rate (kg/d) / Body Weight (kg))

This is considered a screening-level dose assessment because it is based on the *maximum* site-wide COPC concentrations in sediment and surface water. This approach is conservative because it uses maximum rather than average COPC concentrations and assumes that potentially exposed receptors consume food items and water from the most contaminated sources without dilution with uncontaminated or less contaminated food and water. It is assumed that COPCs for which MDD_{pot} values are below chronic effects threshold concentrations or recommended safe concentrations have low likelihood of adverse food chain or food web effects.

Equation input parameters such as food ingestion rate, water intake rate, dietary composition, body weight, etc. for the two representative organisms (belted kingfisher and red fox) are taken from Exposure Factors Handbook (EPA 1993). Where multiple values are presented, the average is used. BCFs are taken from EPA water quality criteria documents if available or estimated from Kow using structure/activity relationships presented in EPA 1988a. Bioaccumulation factors (BAFs), which include both food and water intake, are estimated from

literature-based BCFs (which include water uptake only) and from site-specific or predicted sediment/water partition factors using equilibrium partitioning. The dose calculations presented in Table 9 include both intake of drinking water and prey items, based on maximum detected COPC concentrations in surface water and sediment.

MDD_{pot} values are derived and presented in Table 9 for each of the nine COPCs that are highly bioconcentratable. These values are compared to chronic effects threshold concentrations (mg/kg/d) or recommended safe concentrations (mg/kg/d) for the representative ecological receptors. Effects data are based on sublethal effects in test organisms related to representative receptors. For example, effects data for red fox are based primarily on laboratory data for dogs, while kingfisher data are based on toxicity results from other bird species such as quail and mallard duck. The uncertainties associated with these extrapolations are offset to some degree by the use of conservative assumptions. The dose calculations therefore probably overestimate rather than under-estimate dose-related risks for the representative receptor groups.

Sublethal effects data for test organisms are adjusted for the body weights and ingestion rates of representative receptors. Also, most laboratory effects data for birds and mammals are based on COPC concentrations in the diet (mg/kg diet), and these values are adjusted for ingestion rates and body weights to derive daily dose values (mg/kg/d).

Table 9
Maximum Daily Dose (mg/kg/d) Calculations for Selected COPCs and Ecological Receptors

Calculated Dose / Limit	DDD	DDE	Aroclor 1254	Dieldrin Aldrin	Endrin Ketone	Endrin Aldehyde	Alpha Chlordane
Belted Kingfisher dose	0.0001	0.0000	0.0019	0.0046	0.0030	0.0033	0.0000
Belted Kingfisher dose limit (mg/kg/d)	40 mallard duck oral $LC_{50}/100$	16 est. from DDT	16.6 mallard duck oral $LC_{50}/100$	0.40 sparrow $LD_{50}/100$	0.83 quail, reduced egg production (est. from endrin)	0.83 (est. from endrin)	0.25 rec. dietary limit for birds
Red Fox dose	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
Red Fox dose limit (mg/kg/d)	20 adrenal cortex atrophy	0.5 est. from DDT $LD_{50}/100$	0.0143 rec. daily dietary limit for dogs	0.2 reproductive effects in raccoon	0.1 dog, increased liver size (est. from endrin)	0.1 (est. from endrin)	0.075 NOAEL dog

The results of the screening level dose calculations reveal little likelihood of significant adverse effects to upper trophic level organisms from onsite or near-site exposures to 4,4'-DDD, 4,4'-DDE, aldrin, alpha chlordane, Aroclor 1254, dieldrin, endrin ketone, and endrin aldehyde. In no case does the maximum calculated dose for representative piscivorous birds and top mammalian predators exceed recommended or critical dietary thresholds for relevant species.

4.2 Uncertainty Evaluation - Risk Characterization

By definition, uncertainties in risk characterization are influenced by uncertainties in exposure assessment and effects assessment. Uncertainties in exposure assessment are considered to be minimized by the extensive recent sampling and analysis of surface water and sediment. Descriptions of the magnitude and distribution of COPCs within the site are considered to be reasonably representative of actual conditions to which ecological receptors may be exposed.

Effects data can also contribute to overall uncertainty in risk characterization. At one extreme, for example, there are no toxicologically-based effects data for certain COPCs in sediment, hence there is a high degree of uncertainty associated with these chemicals. At the other extreme, effects data from multiple sources are available for many COPCs in surface water. There is obviously more confidence in risk estimates based on highly certain effects data compared to risk estimates based on data extrapolated from other related species, other chemicals, or estimated toxicological data based soley on chemical structure or properties.

Another source of uncertainty is the simple food web model used to assess food web impacts or impacts due to ingestion of prey contaminated with one or more of the COPCs previously identified as highly bioconcentratable. All models, including simplified models such as the one used in this ERA to evaluate bioaccumulation in upper trophic level predators, are associated with uncertainty. In general, more complex models have greater potential to introduce unacceptable levels of uncertainty unless critical and specific information on input parameters are available. For example, aquatic food web models have been established that calculate biomagnification factors (BMFs) for organic contaminants from exposure media through all major trophic levels to top predators. These models often require the use and evaluation of input parameters that are currently unknown, such as contaminant depuration rates for a particular species. Often, values for other species or even other chemicals are used to represent the required input parameter. These models are often sensitive to slight differences in input parameter values, and results can therefore be highly uncertain. The uncertainty in resulting BMF estimations for higher trophic level organisms are also magnified because the model is based on addition and multiplication of values from lower trophic levels. For these reasons, complex computer-based food chain models are not considered appropriate for this assessment.

Where potential levels of uncertainty could adversely affect the results of the assessment, conservative approaches were taken that may result in over-protection of some local species. For example, many simple food chain models commonly predict, largely as a result of home range estimates, little or no risk to top predators from ingestion of contaminated prey. The site foraging factor (SFF) calculated from large home range estimates can therefore "drive" the model output (i.e., the daily dose) for certain potentially important species. As discussed

above, the foraging behavior of individual organisms and even populations are sufficiently unknown to warrant a more conservative or protective approach. To err on the side of over-protection is considered prudent and, in fact, follows regulatory guidance. This ERA therefore uses a SFF of 1.0 for all receptors, based on the assumption that (1) all foraging takes place onsite (a reasonable assumption for most representative species) and (2) all foraging takes place at contaminated areas (a very conservative assumption for estimating "worst case" scenarios).

Another potentially significant cause of uncertainty in the food web model is the variability of values associated with certain input parameters to the model. Averaging the range of available values (e.g., body weights, intake rates, etc.) is expected to limit uncertainty to an acceptable degree in most cases. For example, there is reasonable concurrence by investigators on input parameters such as body weights and intake rates. In contrast, there is greater variability in literature values for BCFs and, to a lesser degree dietary fractions. These values are therefore more uncertain. Finally, LOAECs, criteria, and recommended limits are based on national databases or are intended to protect large and diverse groups of organisms (i.e., aquatic life, mammals, etc.). These values may therefore be over- or under-protective of certain local species and/or populations. It is unlikely that this assessment underestimates risk because conservative approaches are used where appropriate, and any uncertainties are probably biased towards over-protection.

Science and scientific investigations can not prove any hypothesis beyond doubt. The scientific method is instead based on stating hypotheses, testing these hypotheses, and either accepting or rejecting the hypotheses based on the evidence provided by test data. Test data may include both high quality data as well as highly uncertain data. Cause and effect relationships can be inferred from these data, and evidence can support hypotheses, but cause and effect relationships can rarely be proven regardless of the quality of the data. The risk assessment summary presented below discusses the results testing the three primary hypotheses presented in the Problem Formulation stage of the ERA.

These hypotheses are tested by using an approach that provides support for either rejection or acceptance of the proposed hypotheses. No data are conclusive. Even site-specific effects data, for example, are subject to concerns of representativeness because test species and conditions may not represent actual conditions. More general literature-based toxicity data may not be sufficiently applicable to the site being investigated. There are also concerns about laboratory-to-field extrapolation of effects data. Taxa-to-taxa extrapolations are a concern as well. All effects data are therefore subject to some degree of uncertainty. Confidence in the ability of selected effects data to assess potential for ecological risks varies for each data value selected. While each and every effects data value used in this and every other ERA is associated with some degree of uncertainty, it is the general trend described by the comparisons between exposure concentrations and effects concentrations, and the overall confidence in such comparisons, that are most important.

The impact of cumulative risks or effects from exposure to multiple chemical stressors is another area of uncertainty in the ERA. As stated previously, it is generally assumed that risks from individual chemical stressors are additive. This assumption is based on limited data where

the effects of exposures to multiple chemicals were investigated. The actual impact of exposure to multiple chemical stressors on ecological receptors is unknown because additive toxicity has not been confirmed for most chemical combinations.

Finally, the risk characterization method itself can contribute to uncertainties in the ERA. The simplified approach used here to calculate risks, termed the quotient method, is a useful screening-level approach that may not be appropriate for more complete investigations. The uncertainties common to this method are minimized in this ERA by evaluating multiple sources of data for deriving appropriate effects data rather than relying on a single data source. Quantitative effects data used in this ERA include a variety of criteria, thresholds, recommended safe values, and effects concentrations that are selected for use based on relevance and acceptability.

4.3 Summary and Conclusions of the Ecological Risk Assessment

Risks to ecological receptors are summarized below, within categories designated as LOW RISK and NO RISK. No sources of MODERATE or HIGH RISKS are identified for this ERA. The differentiation of LOW and NO RISKS is used to evaluate the *relative* risks associated with specific stressors compared to all other potential contributors to risk. These designations are based on both the quantitative risk estimates presented previously and best professional judgment.

LOW RISK

- *Sensitive aquatic biota* such as benthic invertebrates can be adversely affected by direct contact with *surface water* in the creek adjacent to Area 7. The only COPC of concern in water at this location is:

  1,1,1-trichloroethane

- *Similar organisms* may be additionally at risk from direct contact with creek *sediments*. Major sediment-associated COPCs at this location include:

  benzo(a)anthracene
  methoxychlor
  chrysene

NO RISK

- Aquatic and semi-aquatic organisms do not appear to be at significant risk from any other COPCs identified at this site.

- Consumers of aquatic and semi-aquatic organisms (e.g., piscivorous birds, omnivorous upper trophic level predators), represented by belted kingfisher and red fox, respectively, do not appear to be at significant risk.

The primary hypotheses for this ERA, initially presented in the Problem Formulation phase of the ERA, are re-evaluated here and used to help summarize risk conclusions. These are discussed below:

> *Chemical contaminants are not present in surface water or sediment onsite or adjacent to the site*

Exposure data support the REJECTION of this hypothesis because contaminants have been detected in creek water and sediments.

> *The concentrations of chemical contaminants are not sufficiently elevated to impair the survival, growth, or reproduction of sensitive ecological receptors*

Effects data support the REJECTION of this hypothesis because a limited number of chemical contaminants are present in surface water or sediments at concentrations sufficiently elevated to elicit adverse effects in sensitive exposed receptors.

> *Known or potential ecological receptors are not sufficiently exposed to chemical contaminants to cause adverse population-level or community-level effects*

The integration of exposure and effects data suggest that certain types of ecological receptors (e.g., benthic invertebrates) may be low levels of risk under certain exposure scenarios (e.g., if they reside primarily in contaminated areas. This hypothesis can not therefore be UNCONDITIONALLY ACCEPTED based on available data. The evidence presented in this ERA suggests that this hypothesis should be REJECTED for portions of the creek where contaminant concentrations exceed risk-based thresholds. It is therefore considered prudent to REJECT this hypothesis for limited and specific locations.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: September 2, 1999

SUBJECT: *Southeast Rockford December 16, 1998 Sampling Preliminary Analytical Results*

FROM: John Frank, Ecology Technical Center Intern, Superfund Division, Remedial Response Section 1
Brenda Jones, Ecologist, Superfund Division, Remedial Response Section 1

TO: Jerry Willman, Project Manager, Illinois Environmental Protection Agency

The purpose of this memo is to provide comments to the Illinois Environmental Protection Agency and Russell Hart, USEPA regarding the *Southeast Rockford December 16, 1998 Sampling Preliminary Analytical Results.*

The maximum concentration of each analyte was compared to an ecological screening benchmark obtained from one of several sources. The results of this analysis as well as the benchmark sources are contained in Tables 1 and 2. Because this is a preliminary screening of potential ecological risk, a conservative approach is warranted. Consequently, maximum concentrations of contaminants were evaluated and the lowest (most conservative) screening benchmark was used.

Of the 41 analytes found at detectable levels in sediment for which ecological screening benchmarks are available, 16 exceed the appropriate benchmark. Most analytes that exceed benchmark values are polycyclic aromatic hydrocarbons (PAHs). Refer to Table 1 for more details on sediment contaminants.

Of the 34 analytes found at detectable levels in surface water for which ecological screening benchmarks are available, 8 exceed the appropriate benchmark. Most analytes that exceed benchmark values are metals. Refer to Table 2 for more details on surface water contaminants.

The exceedance of many of the benchmarks for both sediment and surface water suggests that additional sampling is justified in order to further characterize the potential ecological risk at the site.

As stated in the previous memo, USEPA has been provided with very little information regarding the ecological setting of the site. Therefore, it is difficult to ascertain what possible receptors are at risk as well as the ecological significance of the site itself.

Please address any comments or questions to John Frank (312-886-7180, **frank.john@epa.gov**) or Brenda Jones (312-886-7188, jones.brenda@epa.gov).

cc: Russell Hart

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TABLE 1

Sediment Contaminant Maximum Concentrations and Ecological Screening Benchmarks

SAMPLE	ANALYTE	MAX CONC. (mg/kg)	BENCHMARK (mg/kg)[2]
X101	Naphthalene	0.063 (*)[1]	0.0346 (Canada interim; Florida threshold)
X101	Acenaphthene	0.170 (*)	0.00671 (Canada interim; Florida threshold)
X101	Dibenzofuran	0.091	-
X101	Fluorene	0.180 (*)	0.010 (NOAA lowest threshold)
X101	Phenanthrene	1.300 (*)	0.049 (Canada interim)
X101	Anthracene	0.240 (*)	0.03162 (ARCS threshold)
X101	Carbazole	0.310	-
X101	Fluoranthene	1.600 (*)	0.03146 (NOAA lowest threshold)
X101	Pyrene	1.300 (*)	0.04427 (NOAA lowest threshold)
X101	Benzo(a)anthracene	0.690 (*)	0.0317 (Canada interim)
X101	Chrysene	0.740 (*)	0.02683 (NOAA lowest threshold)
X101	Benzo(b)fluoranthene	0.870	-
X101	Benzo(k)fluoranthene	0.340 (*)	0.0272 (NOAA lowest threshold)
X101	Benzo(a)pyrene	0.590 (*)	0.0319 (Canada interim)

X101	Indeno(1,2,3-cd)pyrene	0.440 (*)	0.01732 (NOAA lowest threshold)
X101	Dibenzo(a,h)anthracene	0.110 (*)	0.00622 (Canada interim; Florida threshold)
X101	Benzo(g,h,i)perylene	0.390 (*)	0.170 (Ontario low)
X102	Di-n-butylphthalate	0.110	-
X102	Vinyl chloride	0.028	-
X102	Chloroethane	0.014	-
X102	Acetone	0.029	-
X102	1,1-Dichloroethane	0.110	-
X102	1,2-Dichloroethane (total)	0.190	-
X102	1,1,1-Trichloroethane	0.062	-
X102	Trichloroethene	0.004	-
X102	Aluminum	12600.00	58030.00 (ARCS probable)
X102	Barium	102.00	-
X101	Calcium	29100.00	-
X102	Cobalt	5.10	-
X102	Chromium (+3 or +6)	17.50	26.00 (Ontario low)
X102	Copper	15.10	16.00 (Ontario low)
X102	Iron	13400.00	-
X102	Potassium	1320.00	-
X101	Magnesium	14400.00	-
X102	Manganese	252.00	460.00 (Ontario low)
X102	Sodium	551.00	-
X102	Nickel	12.10	16.00 (Ontario low)

X102	Lead	88.90 (*)	30.20 (Florida threshold)
X102	Vanadium	31.20	-
X102	Zinc	78.80	94.15 (NOAA low)
X101	Heptachlor epoxide	0.0026 (*)	0.00060 (Canada interim)

1 (*) = maximum analyte concentration exceeds ecological screening benchmark

2 ARCS probable = Assessment and Remediation of Contaminated Sediments (ARCS) Program of National Biological Service for USEPA Great Lakes National Program Office - Probable Effect Concentration (PEC)
http://www.hsrd.ornl.gov/ecorisk/reports.html (sediment report, Table 4, p.17)

Canada interim = Canadian Sediment Quality Guidelines for the Protection of Aquatic Life - Interim Freshwater Sediment Quality Guidelines (ISQGs)
http://www.ec.gc.ca/ceqg-rcqe/sediment.htm

Florida threshold = Florida Department of Environmental Protection, Office of Water Policy - Sediment Quality Assessment Guidelines (SQAGs) Threshold Effect Levels
http://www.dep.state.fl.us/dwm/documents/sediment/default.htm (Table 5, p.77)

NOAA lowest threshold = National Oceanic and Atmospheric Administration Screening Quick Reference Tables (SQUIRTs) - Freshwater Sediment Lowest ARCs *H. azteca* Threshold Effect Level (TEL)
http://response.restoration.noaa.gov/living/SQuiRT/SQuiRT.html

Ontario low = Ontario Ministry of the Environment - Lowest Effect Level
http://www.hsrd.ornl.gov/ecorisk/reports.html (sediment report, Table 4, p.17)

TABLE 2

Surface Water Contaminant Maximum Concentrations / Ecological Screening Benchmarks

SAMPLE	ANALYTE	MAX CONC. (ug/L)	BENCHMARK (ug/L)[2]
S203	bis(2-Ethylhexyl)phthalate	13.00	-
S202	Vinyl chloride	48.00	-
S202	Chloroethane	87.00	-
S201	Acetone	17.00	-
S202	1,1-Dichloroethene	88.00	-
S202	1,1-Dichloroethane	1000.00 E, 1300.00 D	-
S202	1,2-Dichloroethene	1700.00 E, 2200.00 D	-
S202	Chloroform	10.00	-
S202	1,2-Dichloroethane	40.00	100.00 (Canada)
S202	1,1,1-Trichloroethane	1200.00 E, 1800.00 D	18000.00 (NOAA acute)
S202	Trichloroethene	22.00	-
S201	Tetrachloroethene	10.00	-
S201	1,1,2,2-Tetrachloroethane	10.00	-
S201	Toluene	10.00 (*)[1]	2.00 (Canada)
S202	Xylene (total)	21.00	-
S204	Aluminum	27900.00 (*)	5-100.00 (Canada)
S204	Arsenic	149.00	150.00 (AWQC)
S204	Barium	1840.00	-
S204	Beryllium	1.40	5.30 (NOAA chronic)
S204	Calcium	217000.00	-

S204	Cobalt	31.00	-
S204	Chromium (+3 or +6)	46.90 (*) for Cr +3	11 (+3), 74 (+6) (AWQC)
S204	Copper	84.90 (*)	9.00 (AWQC)
S204	Iron	527000.00 (*)	1000.00 (AWQC)
S204	Mercury	0.39	0.77 (AWQC)
S204	Potassium	4530.00	-
S204	Magnesium	77200.00	-
S204	Manganese	8670.00	-
S203	Sodium	11900.00	-
S204	Nickel	46.00	52.00 (AWQC)
S204	Lead	108.00 (*)	2.50 (AWQC)
S204	Antimony	7.00 (*)	3.0 (NOAA chronic)
S204	Vanadium	90.10	-
S204	Zinc	340.00 (*)	120.00 (AWQC)

1 (*) = maximum analyte concentration exceeds ecological screening benchmark

2 AWQC = USEPA - Ambient Water Quality Criteria Freshwater Criterion Continuous Concentration (CCC)
National Recommended Water Quality Criteria - Correction EPA 822-Z-99-001 April 1999

Canada = Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Water Quality Guidelines
http://www.ec.gc.ca/ceqg-rcqe/water.htm

NOAA = National Oceanic and Atmospheric Administration Screening Quick Reference Tables (SQUIRTs) - Freshwater Acute or Chronic
http://response.restoration.noaa.gov/living/SQuiRT/SQuiRT.html

Response to Comments on
The Draft Ecological Risk Assessment for Area 7
Southeast Rockford Source Control Operable Unit

Information Needs and Clarifications

A description of the ecology of Area 7 is not available.

The references provided in Table 6 can be used to obtain specific information on the study details used to derive effects concentrations. A brief description of the categories of effects concentrations is given below.

EPA chronic criteria are based on laboratory toxicity studies in which a variety of freshwater fish, benthic and water column invertebrate species are exposed to laboratory water "spiked" with a range of concentrations of a specific chemical toxicant. Chronic tests are short-term tests (generally 48 hours to seven days) with test endpoints related to effects on organism survival, growth, and reproduction. Criteria are generated from regression analysis of all test data, with the four most sensitive organisms having the most influence on the final criterion.

Secondary chronic values were derived by Oak Ridge National Laboratory in a manner similar to that used by EPA to derive chronic criteria. The primary difference is that ORNL's Secondary Chronic Values are based on smaller datasets that did not meet the minimum requirements of EPA.

Threshold effects levels derived by the Florida Department of Environmental Protection (FDEP) used an approach similar to that used by NOAA to derive Effects Range-Low (ER-L) and Effects Range-Median (ER-M). These levels are based on coastal marine and estuarine sediment chemistry and associated biology. Chemical concentrations predicted to be associated with adverse biological effects are ranked, and ER-L represents the 10th percentile of ranked concentrations. ER-M represents the median concentration. FDEP calculates the Threshold Effects Level (TEL), which is the mean of the 15th percentile in the data set. FDEP also calculates the Probable Effects Level (PEL), which is the geometric mean of the 50th percentile of the data set. All of these thresholds are based on effects to a variety of benthic macroinvertebrates.

The equation used to estimate BCF from log K_{ow} is that of Veith and Kosian (1982) in EPA 1988a. The equation follows:

$$\log BCF = 0.79 \log K_{ow} - 0.40$$

As stated in the ERA, the input parameters for estimated maximum daily doses of bioconcentratable COCs were taken from EPA's Exposure Factors Handbook (EPA 1993). These input parameters include the following:

Species	NIR (food) g/g-d	NIR (water) g/g-d	Dietary Fraction
Belted Kingfisher	0.83	0.11	0.8 fish 0.2 inverts
Red Fox	0.10	0.085	0.6 mammals 0.25 birds 0.1 plants 0.05 inverts

The concentration of COCs in food items are estimated by multiplying the maximum COC concentration in exposure media (e.g., surface water, Table 1) by the COC-specific BCF or bioaccumulation factor (BAF), taken from Table 3 of the ERA.

The reference in the ERA on Page 19 to the EPA-recommended EP approach is intended only to identify the source of the various sediment thresholds used in the ERA. The Jones, Suter, and Hall 1997 document was used as a source for several different types of sediment thresholds, including those based on EPA's recommended EP approach. The literature reference was not intended to imply that this was an EPA document.

Choice of Receptors and Media

Early on in the ERA process it was decided by all interested parties that this ERA should be a screening level ERA rather than a full baseline ERA. This ERA was therefore focused on the major exposure pathways and most likely contributors to ecological risk. Not all exposure pathways and receptors were assessed in the ERA, and inhalation-related exposures that might be caused by VOCs in surface soils, for example, were not assessed.

Similarly, amphibians were also not directly or fully assessed in the ERA. However, amphibians are indirectly assessed in the ERA by using water quality criteria and other surface water benchmark concentrations that in some cases include or are based on toxicity data associated with amphibian exposures.

Rock River Impacts

As stated above, this ERA was focused on the major exposure scenarios with the greatest likelihood of contributing to ecological risk. Area 7 was the primary area of interest for this ERA. It is agreed that the Rock River is of greater ecological significance than Area 7. However, little or no useable data existed at the time the ERA was conducted to assess Rock River impacts.

It was assumed that Rock River impacts would warrant investigation if hazardous chemicals with significant mobility were expected to be transported offsite via groundwater discharge or surface water runoff. Data are currently lacking to make such an assessment, but as indicated by EPA, there does not appear to be a great

likelihood of offsite transport of those COCs with the highest potential to cause adverse ecological effects (e.g., pesticides, PCBs).

The assumption that the Rock River is at little risk from site-related contamination is based on the information presented in Tables 7 (SW) and 8 (SED) of the ERA. Table 7 reveals that the *maximum* hazard quotient for surface water COCs is 3.3 (1,1,1-trichloroethane)—no other SW COC has a maximum HQ above 1.0. It must be emphasized that these are maximum HQs and therefore may overestimate average risks. This COC may be present in groundwater and there is some potential for groundwater transport to the Rock River. However, data are currently unavailable to assess this possibility.

Maximum sediment-associated hazard quotients above 1.0 are limited to benzo(a)anthracene (6.1), methoxychlor (3.4), and chrysene (2.5). These COCs are expected to bind strongly to sediments. Offsite migration is therefore most likely only if significant surface transport of onsite sediments is expected. Again, these are maximum HQs that may overestimate average or most likely risk. Finally, as stated above, data are currently unavailable to assess the migration of onsite sediments to the Rock River.

APPENDIX B

BACKUP FOR CONTAMINANT FATE AND TRANSPORT ANALYSIS

BIOSCREEN (U.S. EPA 1996) input parameters are listed in Table B.1.1. Most of the values are based on site-specific observations. Parameters such as soil bulk density (ρ), K_{oc}, f_{oc}, and solute half-life ($t_{1/2}$) are from the technical literature. Groundwater half-life values represent the midpoint of the range of half-lives found in Howard *et al.* (1991), as shown in Table B.1.2. First-order decay coefficients are calculated using the equation $\lambda = (0.693)/t(_{½})$. Soluble mass estimates are given in Appendices B.2 to B.5.

Table B.1.1

Input Parameters for BIOSCREEN Model Runs for NO ACTION Alternative

Southeast Rockford Source Control Operable Unit
Focused Feasibility Study
Rockford, Illinois

		Hydrogeology			Dispersion	Adsorption			Biodegradation	Source Data			
	Compound	K (cm/s)	i (ft/ft)	Porosity, n	Estimated Plume Length, L_p (ft)	ρ (kg/L)	K_{oc}(L/kg)	f_{oc}	Solute Half-Life, $t_{1/2}$ (yr)	Sat. Source Thickness (ft)	Source Zone Conc. (mg/L)	1st-Order Source Half-Life (yr)[a]	Soluble Mass (kg)
AREA 4	TCA	1.20E-03	0.008	0.25	350	1.7	110	0.002	0.94	10	887	10	850
AREA 7	TCA	1.20E-03	0.01	0.20	2500	1.7	110	0.002	0.94	15	887	20	8,564
	PCE	1.20E-03	0.01	0.20	2500	1.7	155	0.002	1.5	15	133	>1000	4,146
	TCE	1.20E-03	0.01	0.20	2500	1.7	166	0.002	2.69	15	1,100	6	2,439
	1,2-DCE	1.20E-03	0.01	0.20	2500	1.7	35.5	0.002	4.04	15	2,333	1	1,312
	Xylene	1.20E-03	0.01	0.20	2500	1.7	260	0.002	0.538	15	124	100	6,366
AREA 9/10W	PCE	1.20E-03	0.002	0.25	2500	1.7	155	0.002	1.50	5	200	50	104
AREA 11	Benzene	1.20E-03	0.002	0.25	300	1.7	58.9	0.002	1.00	15	0.023	>1000	17,000
	Xylene	1.20E-03	0.002	0.25	300	1.7	260	0.002	0.54	15	16	>1000	8,278
	Methylene Chloride	1.20E-03	0.002	0.25	300	1.7	11.7	0.002	0.096	15	0.25	>1000	116
	TCE	1.20E-03	0.002	0.25	300	1.7	166	0.002	2.69	15	0.25	>1000	202
	2-Methylphenol	1.20E-03	0.002	0.25	300	1.7	91.2	0.002	0.0219	15	26000	>1000	5

[a]Value calculated by *BIOSCREEN*

Table B.1.2

Half-Life ($t_{1/2}$) and 1st-Order Decay Values for BIOSCREEN Modeling

Southeast Rockford Source Control Operable Unit
Focused Feasibility Study
Rockford, Illinois

		Half-Life in Groundwater, $t_{1/2}$ (yr)[a]			1st-Order
CAS No.	Compound	High	Low	Midpoint	Decay, λ (yr^{-1})[a]
79-01-6	TCE	4.50E+00	8.79E-01	2.69E+00	0.26
67-66-3	Chloroform	5.00E+00	1.54E-01	2.58E+00	0.27
127-18-4	PCE	2.00E+00	1.00E+00	1.50E+00	0.46
71-43-2	Benzene	2.00E+00	2.74E-02	1.01E+00	0.68
71-55-6	1,1,1-TCA	1.50E+00	3.84E-01	9.42E-01	0.74
1330-20-7	Xylenes (Total)	1.00E+00	7.67E-02	5.38E-01	1.29
100-41-4	Ethylbenzene	6.25E-01	1.64E-02	3.21E-01	2.16
75-09-02	Methylene Chloride	1.53E-01	3.84E-02	9.57E-02	7.24
108-88-3	Toluene	7.67E-02	1.92E-02	4.80E-02	14.45
95-48-7	2-Methylphenol	3.84E-02	5.48E-03	2.19E-02	31.59
75-35-4	1,1-DCE	3.62E-01	1.53E-01	2.58E-01	2.69
540-59-0	1,2-DCE (Total)	7.92E+00	1.54E-01	4.04E+00	0.17
156-59-2	cis-1,2-DCE	NL	NL	#VALUE!	#VALUE!
107-06-2	1,2-DCA	1.00E+00	2.74E-01	6.37E-01	1.09
79-00-5	1,1,2-TCA	2.00E+00	3.75E-01	1.19E+00	0.58
121-14-2	2,4-Dinitrotoluene	1.00E+00	5.48E-03	5.03E-01	1.38

[a]Source: Howard *et al.* (1991); based on midpoint of half-life range

NL Not Listed

Table B.1.3

Aqueous Solubilities and Organic Carbon Partition Coefficients (K_{oc}) Used in BIOSCREEN Modeling

Southeast Rockford Source Control Operable Unit
Focused Feasibility Study
Rockford, Illinois

CAS No.	Compound	Aqueous Solubility (mg/L)[a]	Koc Partition Coeff. (L/kg)[a]
79-01-6	TCE	1,100	166
67-66-3	Chloroform	7,920	39.8
127-18-4	PCE	200	155
71-43-2	Benzene	1,750	58.9
71-55-6	1,1,1-TCA	1,330	110
1330-20-7	Xylenes (Total)	186	260
100-41-4	Ethylbenzene	169	363
75-09-02	Methylene Chloride	13,000	11.7
108-88-3	Toluene	526	182
95-48-7	2-Methylphenol	26,000	91.2
75-35-4	1,1-DCE	2,250	58.9
540-59-0	1,2-DCE (Total)	3,500[b]	35.5[b]
156-59-2	cis-1,2-DCE	3,500	35.5
107-06-2	1,2-DCA	8,520	17.4
79-00-5	1,1,2-TCA	4,420	50.1
121-14-2	2,4-Dinitrotoluene	270	95.5

[a]Source: TACO Guidance, IL Adm. Code, Section 742, Appendix C, Table E

[b]Value for cis-1,2-DCE listed

Soluble Mass Estimate for 1,1,1-TCA in Area 4 Soil

APPENDIX B12

AREA 4 INPUT PARAMETERS AND BIOSCREEN OUTPUT

Arithmetic mean of three highest soil concentrations in Source Area 4 from CDM (1995) and CDM (1997):

SB-202-8	510 mg/kg
SB-4-1-F	360 mg/kg
SB-4-5F	190 mg/kg
MEAN	350 mg/kg

Volume of contaminated soil = 50,400 ft^3 = 1.43 x 10^6 L (from Appendix C)

Soil Bulk Density = 1.7 kg/L

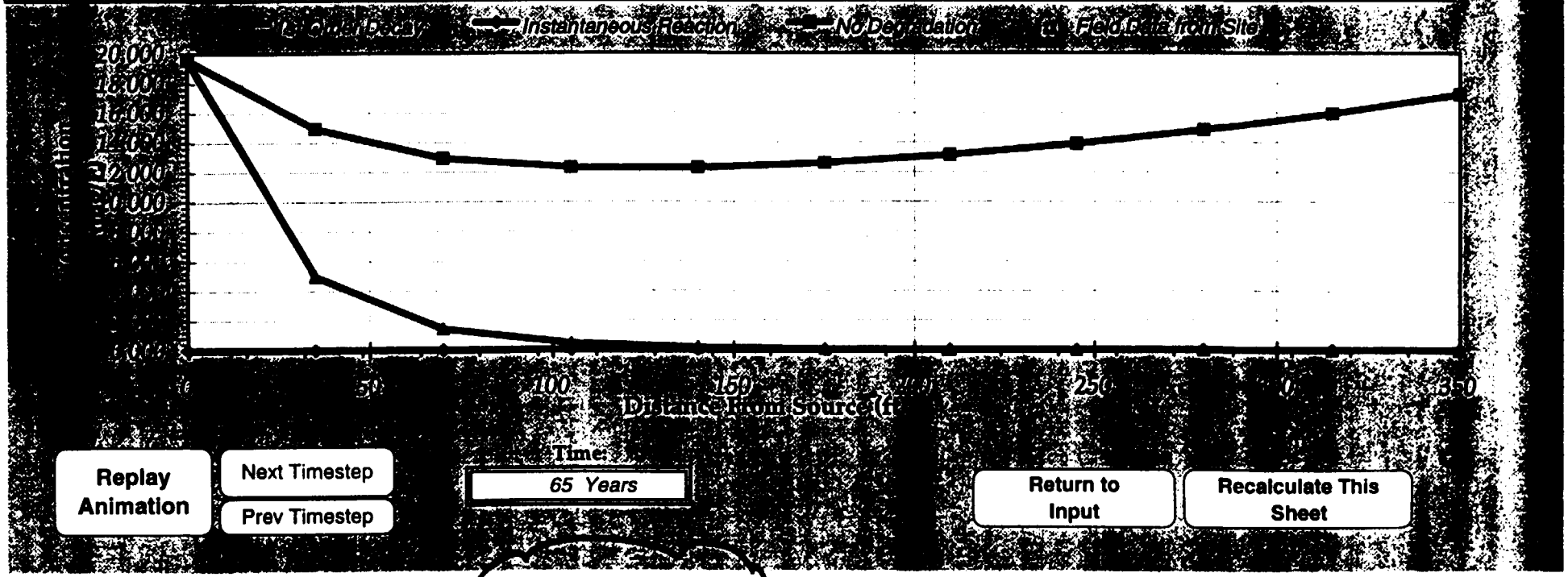
Mass of Contaminated Soil = (1.43 x 10^6 L) x (1.7 kg/L) = 2.431 x 10^6 kg

Mass of TCA = (2.431 x 10^6 kg) x (350 mg/kg) = 850.8 kg (Area 4)

Area 4 TCA -- No Action (SCS-4A and -4B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft)										
	0	35	70	105	140	175	210	245	280	315	350
No Degradation	19.581	14.943	12.919	12.305	12.279	12.592	13.145	13.897	14.831	15.942	17.236
Instantaneous Reaction	19.581	4.968	1.428	0.452	0.150	0.051	0.018	0.006	0.002	0.001	0.000
First Order Decay	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Replay Animation | Next Timestep | Prev Timestep

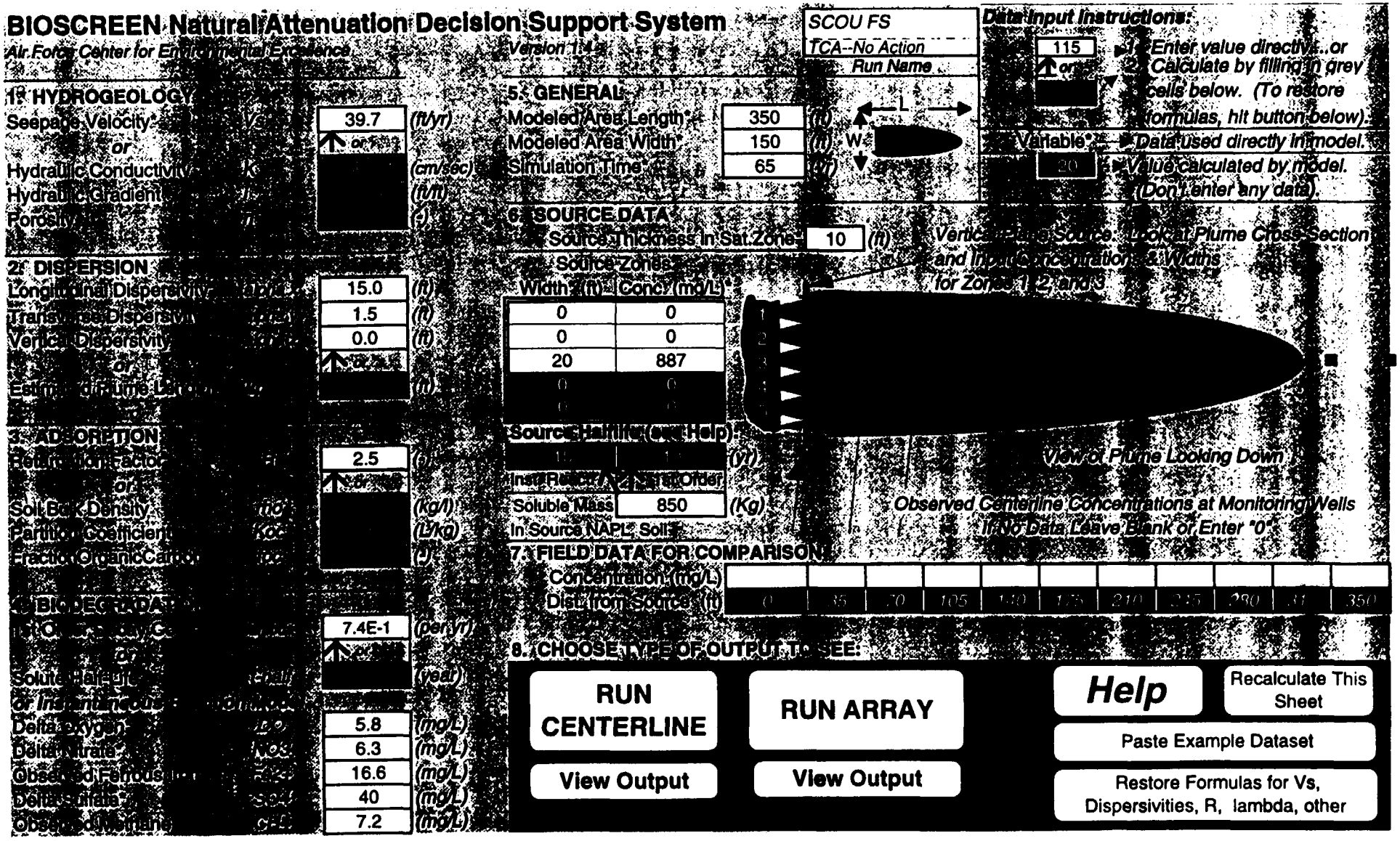
Time: 65 Years

Return to Input | Recalculate This Sheet

60-70 yr

4TCA_S4A.XLS

Area 4 TCA -- No Action (SCS-4A and -4B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone



4TCA_S4A.XLS

Area 4 TCA -- Soil SVE (SCS-4C)

Assume source zone conc. and soluble mass reduced by 85% for SVE; plume length decreased by 50%

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MOD	0	35	70	105	140	175	210	245	280	315	350
No	32.554	28.284	25.177	24.228	24.261	24.804	25.531	26.077	25.979	24.764	22.149
1st Order Decay	32.554	8.509	2.279	0.660	0.199	0.062	0.019	0.006	0.002	0.001	0.000
Instantaneous Reaction	8.469	5.075	2.644	2.225	2.763	3.838	5.141	6.293	6.778	6.023	3.627
No Degradation											

1st Order Decay — Instantaneous Reaction — No Degradation — From Site

Concentration (mg/L)

Distance From Source (ft)

Time:

24 Years

Calculate Animation

Return to Input

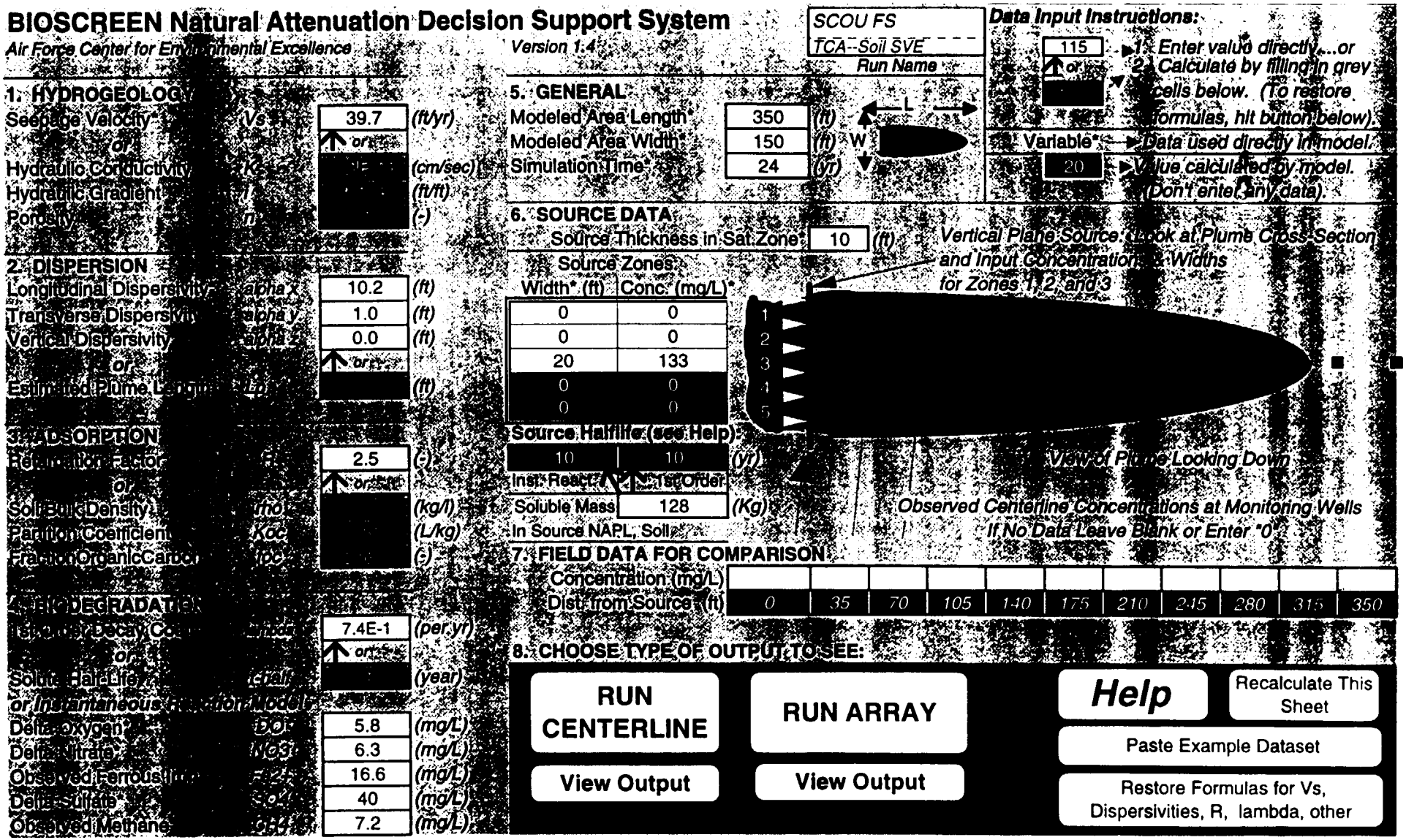
Recalculate This Sheet

20-30 yr

4TCAS4C.XLS

Area 4 TCA -- Soil SVE (SCS-4C)

Assume source zone conc. and soluble mass reduced by 85% for SVE; plume length decreased by 50%



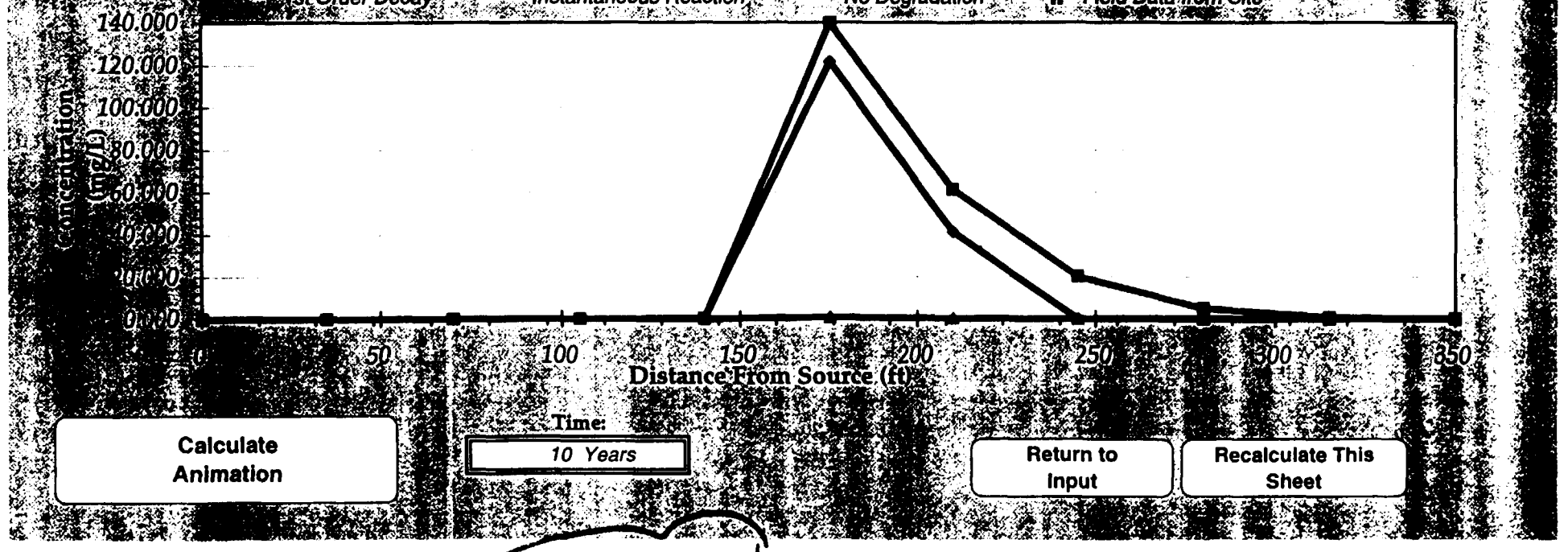
4TCAS4C.XLS

Area 4 TCA -- Soil Thermal Desorp. (SCS-4D)

Assume soluble mass reduced by 99% for thermal desorp; assume leachate conc. remains unchanged @ start of simulation; plume length decreased by 50%

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft): 0	35	70	105	140	175	210	245	280	315	350
No Degradation	0.000	0.000	0.000	0.000	0.213	139.837	61.265	20.190	4.871	0.845	0.104
1st Order Decay	0.000	0.000	0.000	0.000	0.003	0.841	0.209	0.046	0.008	0.001	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	121.612	41.124	0.000	0.000	0.000	0.000
Field Data from Site											



Time: 10 Years

Calculate Animation

Return to Input

Recalculate This Sheet

5-15 yr

4TCA_S4D.XLS

Area 4 TCA -- Soil Thermal Desorp. (SCS-4D)

Assume soluble mass reduced by 99% for thermal desorp; assume leachate conc. remains unchanged @ start of simulation; plume length decreased by 50%

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Soil Thermal
Run Name

Data Input Instructions:

115 or 002

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* --- ▶Data used directly in model.
20 - ▶Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	39.7	(ft/yr)
or		*or*	
Hydraulic Conductivity	K	[illegible]	(cm/sec)
Hydraulic Gradient	I	[illegible]	(ft/ft)
Porosity	n	[illegible]	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	10.2	(ft)
Transverse Dispersivity*	alpha y	1.0	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	LD		(ft)

3. ADSORPTION

Retardation Factor*	R	2.5	(-)
or		*or*	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
FractionOrganicCarbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coeff.*	lambda	7.4E-1	(per yr)
or		*or*	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	350	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	10	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 10 (ft)

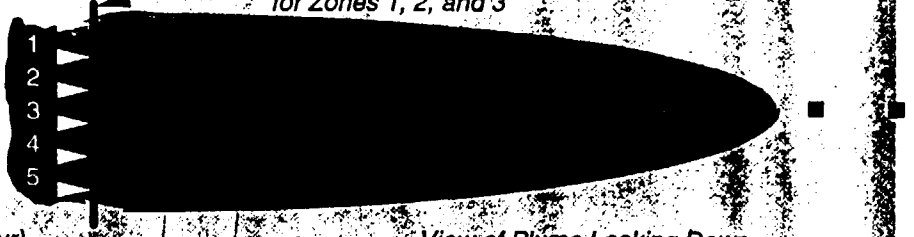
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
0	0
20	887
0	0
0	0

Source Halflife (see Help):

<1	<1	(yr)
Inst. React*	1st Order	
Soluble Mass	9	(Kg)
In Source NAPL, Soil		

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	35	70	105	140	175	210	245	280	315	350
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

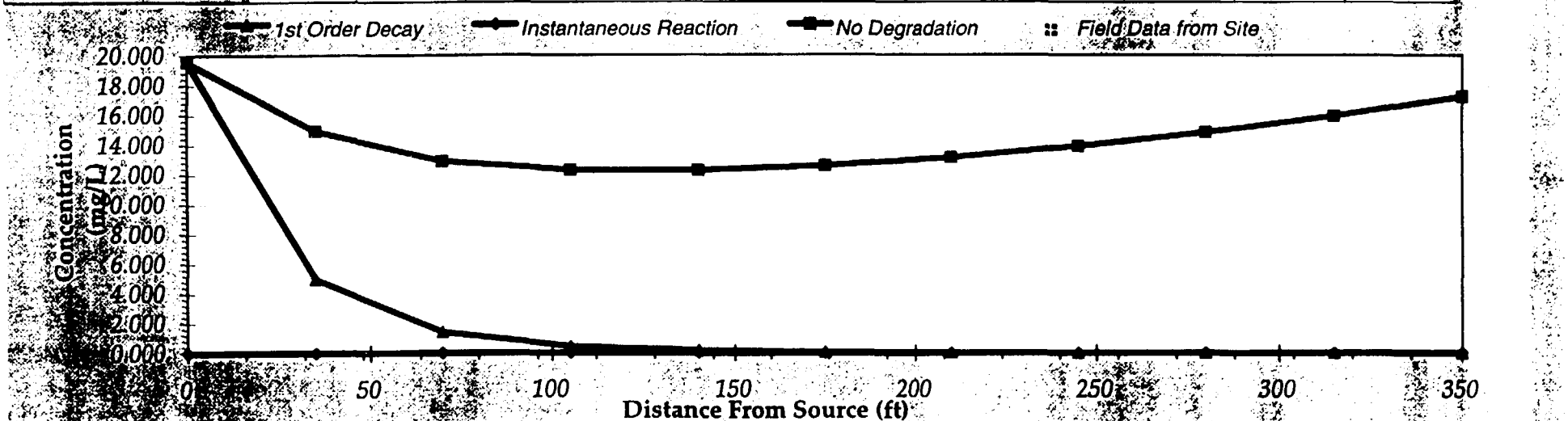
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

Area 4 TCA -- No Action (SCL-4A)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	35	70	105	140	175	210	245	280	315	350
No Degradation	19.581	14.943	12.919	12.305	12.279	12.592	13.145	13.897	14.831	15.942	17.236
1st Order Decay	19.581	4.968	1.428	0.452	0.150	0.051	0.018	0.006	0.002	0.001	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 65 Years

Return to Input

Recalculate This Sheet

60-70 yr.

4TCA_L4A.XLS

Area 4 TCA -- No Action (SCL-4A)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--No Action
Run Name

Data Input Instructions:

115 or [redacted]
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ▶ Data used directly in model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	39.7	(ft/yr)
or		*or*	
Hydraulic Conductivity	K	[redacted]	(cm/sec)
Hydraulic Gradient	I	[redacted]	(ft/ft)
Porosity	n	[redacted]	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	15.0	(ft)
Transverse Dispersivity*	alpha y	1.5	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	Lp	[redacted]	(ft)

3. ADSORPTION

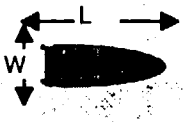
Retardation Factor*	R	2.5	(-)
or		*or*	
Soil Bulk Density	rho	[redacted]	(kg/l)
Partition Coefficient	Koc	[redacted]	(L/kg)
FractionOrganicCarbon	foc	[redacted]	(-)

4. BIODEGRADATION

1st Order Decay Coeff.*	lambda	7.4E-1	(per yr)
or		*or*	
Solute Half-Life	t-half	[redacted]	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	350	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	65	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 10 (ft)

Source Zones:

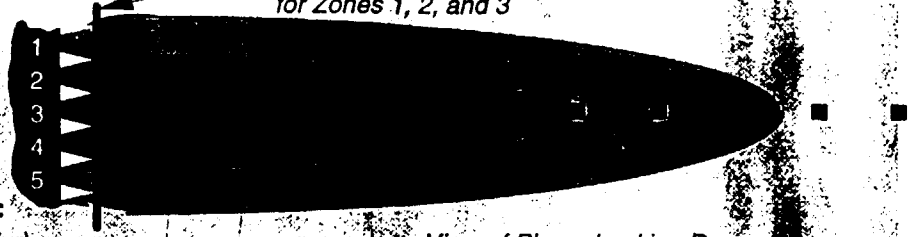
Width* (ft)	Conc. (mg/L)*
0	0
0	0
20	887
0	0
0	0

Source Halflife (see Help):

10	10	(yr)
Inst. React.	1st Order	

Soluble Mass 850 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source* (ft)	Concentration (mg/L)
0	
35	
70	
105	
140	
175	
210	
245	
280	
315	
350	

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

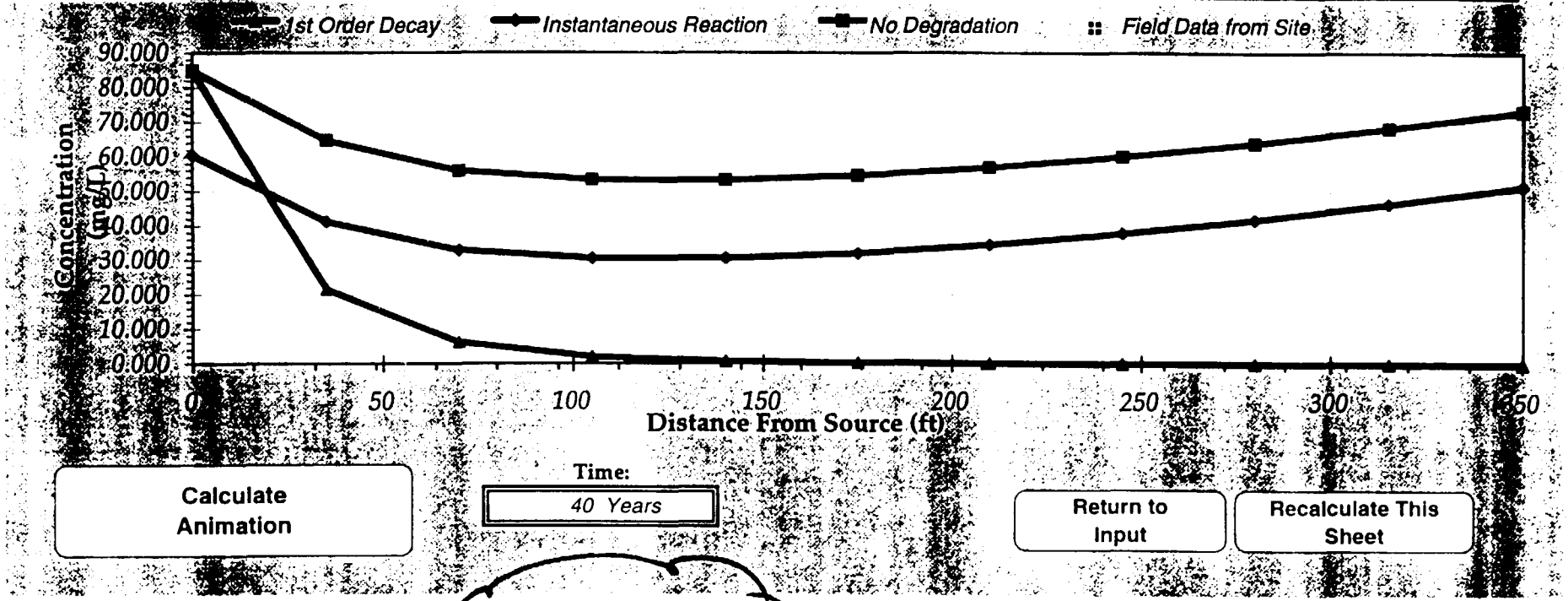
Area 4 TCA -- Limited Action (SCL-4B)

Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone; assume 70% efficiency for air stripping;

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL:	0	35	70	105	140	175	210	245	280	315	350
No Degradation	84.878	64.771	55.999	53.336	53.219	54.559	56.923	60.101	63.969	68.415	73.291
1st Order Decay	84.878	21.536	6.191	1.961	0.651	0.222	0.077	0.027	0.010	0.003	0.001
Inst. Reaction	60.476	41.222	32.879	30.451	30.500	31.982	34.481	37.801	41.825	46.450	51.533
Field Data from Site											



Time:

40 Years

Calculate Animation

Return to Input

Recalculate This Sheet

35 - 45 yr

4TCA_L4B.XLS

Area 4 TCA -- Limited Action (SCL-4B)

Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone; assume 70% efficiency for air stripping;

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Limited Action
Run Name

Data Input Instructions:

115 ▶1. Enter value directly....or
or 2. Calculate by filling in grey
cells below. (To restore
formulas, hit button below).
Variable* – ▶Data used directly in model.
20 ▶Value calculated by model.
(Don't enter any data)

1. HYDROGEOLOGY

Seepage Velocity*	Vs	39.7	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	15.0	(ft)
Transverse Dispersivity	alpha y	1.5	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

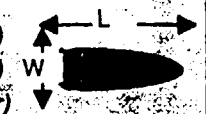
Retardation Factor*	R	2.5	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
FractionOrganicCarbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	7.4E-1	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	350	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	40	(yr)



6. SOURCE DATA

Source Thickness In Sat.Zone* 10 (ft)

Source Zones:

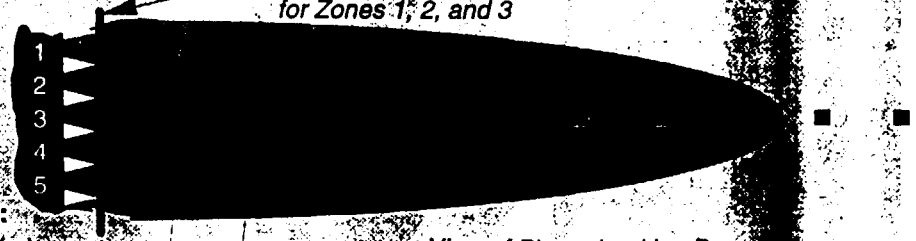
Width* (ft)	Conc. (mg/L)*
0	0
0	0
20	887
0	0
0	0

Source Halflife (see Help):

Inst. React.	1st Order	
10	10	(yr)

Soluble Mass 850 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	35	70	105	140	175	210	245	280	315	350
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

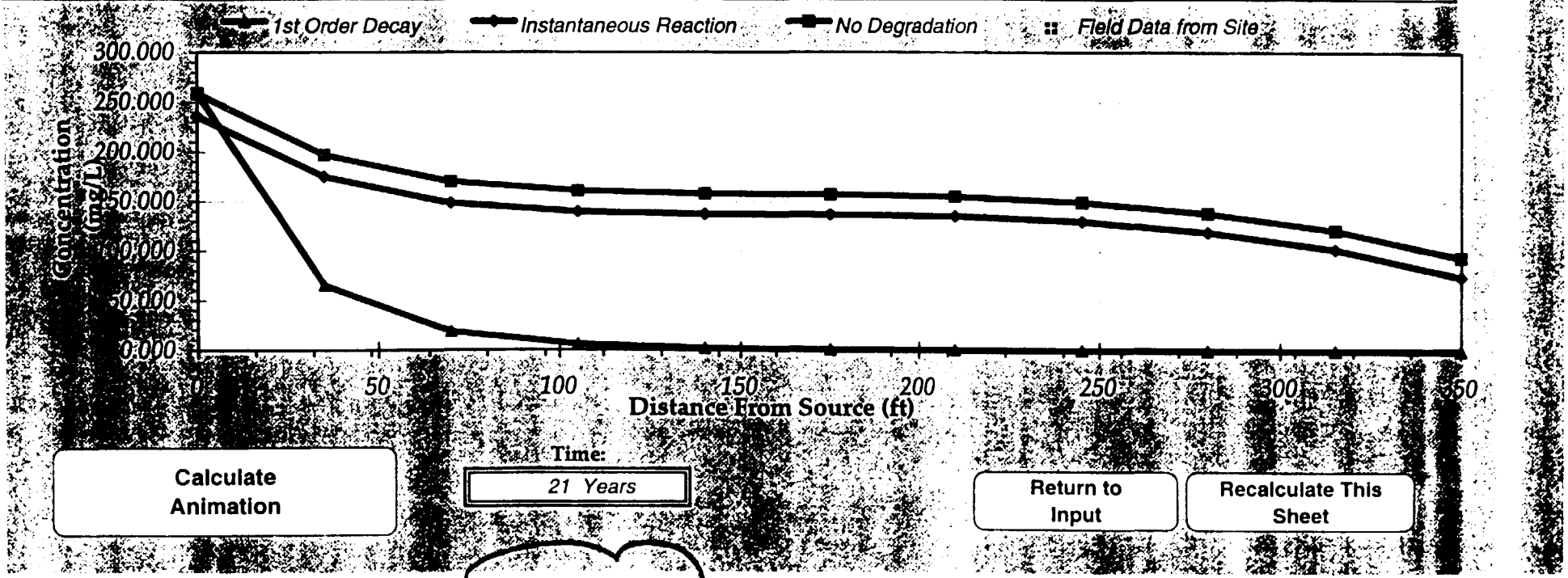
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

Area 4 TCA -- Air Sparging @ GMZ Only (SCL-4C)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	35	70	105	140	175	210	245	280	315	350
No Degradation	258.751	197.179	170.003	160.810	158.008	157.090	155.053	149.408	138.363	121.401	94.058
1st Order Decay	258.751	65.653	18.873	5.977	1.983	0.676	0.235	0.082	0.029	0.010	0.004
Inst. Reaction	235.580	174.991	148.426	139.736	137.424	136.998	135.435	130.193	119.412	102.511	74.717
Field Data from Site											



Calculate Animation

Time: 21 Years

Return to Input

Recalculate This Sheet

15 - 25 yr

4TCA_L4C.XLS

Assume 90% efficiency for air sparging @ GMZ boundary; no source control instituted;

Area 4 TCA -- Air Sparging @ GMZ Only (SCL-4C)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Leachate
Run Name

Data Input Instructions:
115 — *1. Enter value directly....or*
or — *2. Calculate by filling in grey cells below. (To restore formulas, hit button below).*
Variable → Data used directly in model.*
20 — *Value calculated by model. (Don't enter any data).*

1. HYDROGEOLOGY

Seepage Velocity*	Vs	39.7	(ft/yr)
or		*or*	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	15.0	(ft)
Transverse Dispersivity	alpha y	1.5	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor	R	2.5	(-)
or		*or*	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	7.4E-1	(per yr)
or		*or*	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	350	(ft)
Modeled Area Width*	150	(ft)
Simulation Time*	21	(yr)

6. SOURCE DATA

Source Thickness in Sat Zone* 10 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
0	0
20	887
0	0
0	0

Source Halflife (see Help):

Inst. React.	1st Order	
10	10	(yr)

Soluble Mass 850 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	35	70	105	140	175	210	245	280	315	350
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

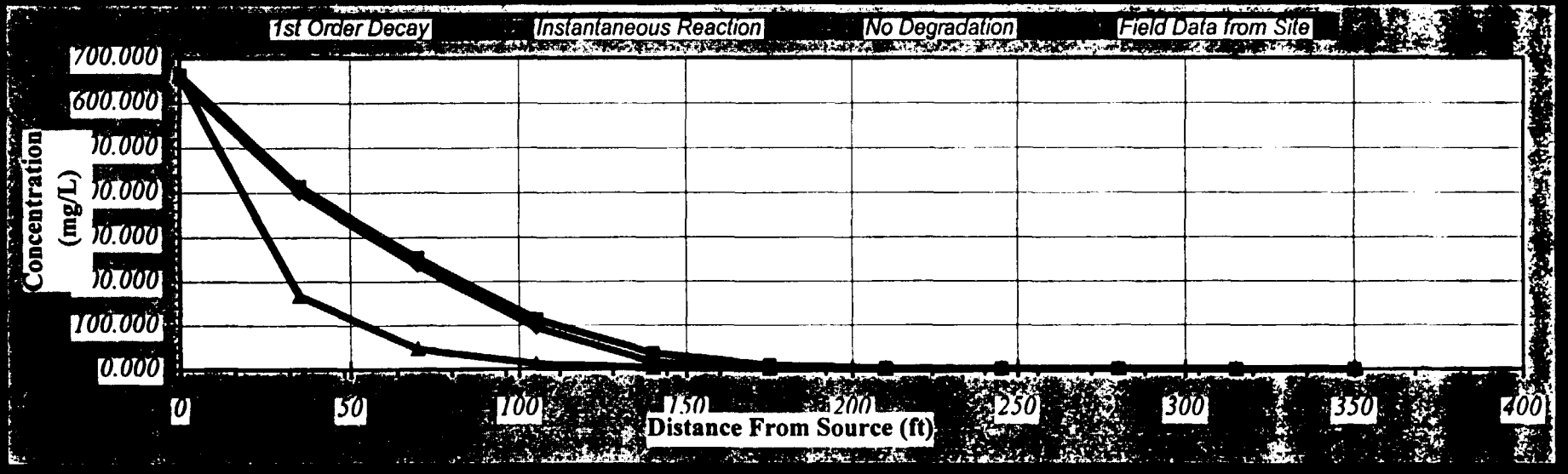
RUN CENTERLINE — View Output
RUN ARRAY — View Output
Help
Recalculate This Sheet
Paste Example Dataset
Restore Formulas for Vs, Dispersivities, R, lambda, other

4TCA_L4C.XLS

Assume 90% efficiency for air sparging @ GMZ boundary; no source control instituted;

Area 4 TCA -- Reactive Barrier Wall @ GMZ Only (SLC-4D)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

661.505	413.529	252.157	114.152	35.934	7.620	1.047	0.091	0.005	0.000	0.000
661.505	166.645	46.248	11.766	2.510	0.413	0.048	0.004	0.000	0.000	0.000
651.173	400.285	236.449	95.300	15.175	0.000	0.000	0.000	0.000	0.000	0.000



Calculate Animation

5 Years

Return to Input

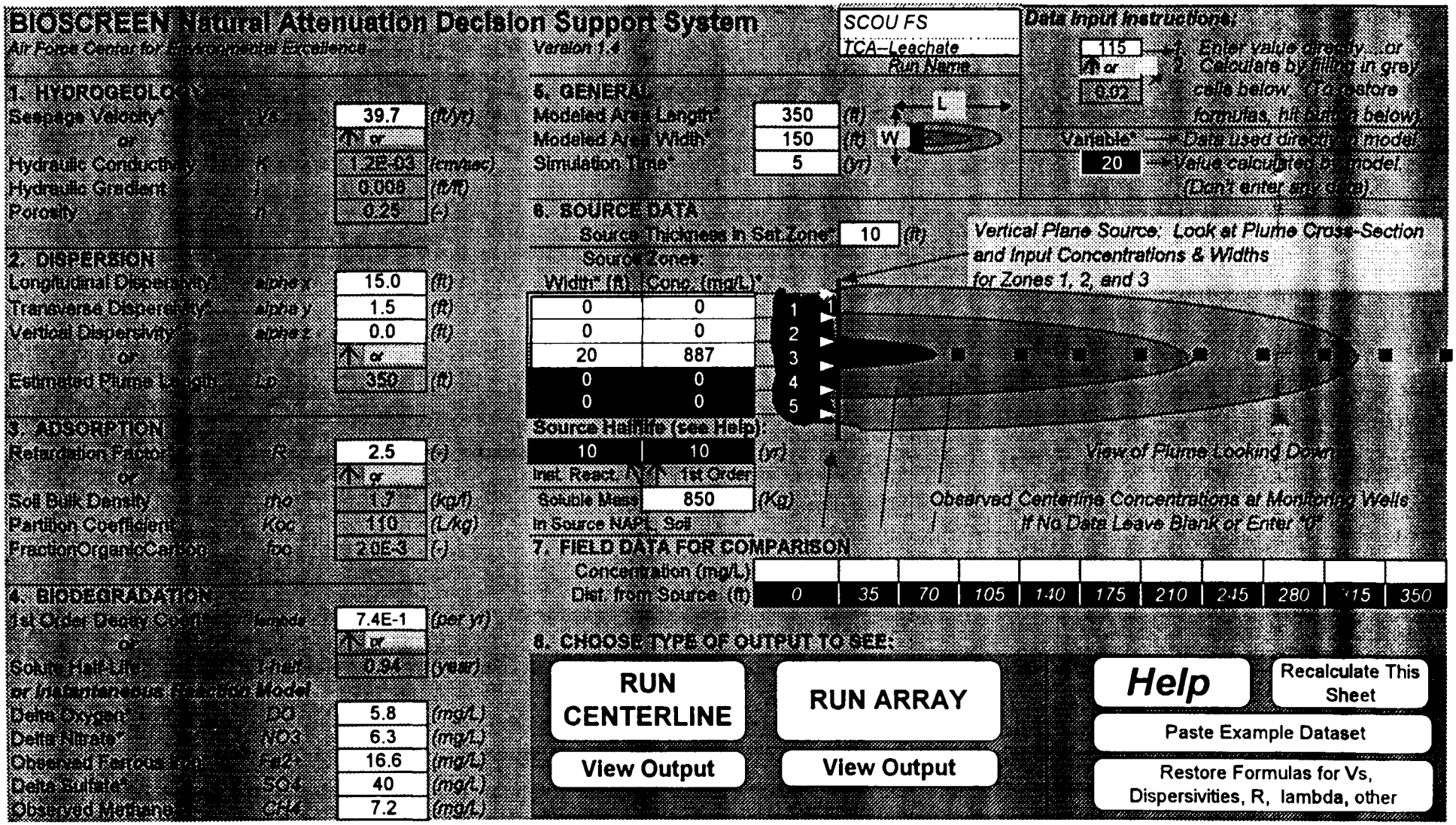
Recalculate This Sheet

4tca_l4d.xls

< 5 yr.

Assume 99.9% efficiency for barrier wall @ GMZ boundary;
no source control instituted;

Area 4 TCA -- Reactive Barrier Wall @ GMZ Only (SCL-4D)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone

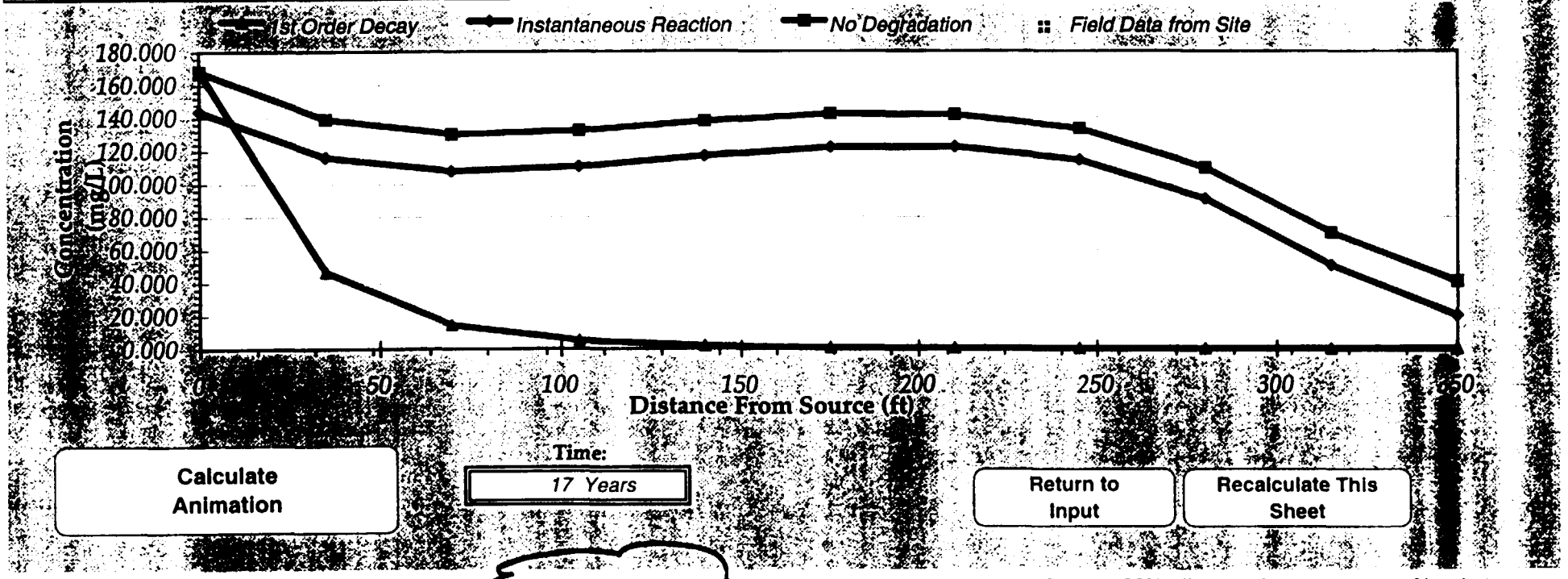


Assume 99.9% efficiency for barrier wall @ GMZ boundary;
no source control instituted;

Area 4 TCA -- Air Sparging @ Source Area and @ GMZ (SCL-4E)

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	35	70	105	140	175	210	245	280	315	350
No Degradation	168.284	139.327	130.148	132.353	137.894	142.333	141.819	133.408	109.742	70.367	40.656
1st Order Decay	168.284	46.533	14.578	5.031	1.819	0.676	0.256	0.098	0.036	0.011	0.003
Inst. Reaction	143.903	116.139	107.740	110.623	116.885	122.096	122.330	114.503	90.783	50.448	20.012
Field Data from Site											



Time: 17 Years

Calculate Animation

Return to Input

Recalculate This Sheet

10 - 20 yr

Assume 90% efficiency for air sparging of leachate;
Assume air sparging reduces soil source conc. by 40%;

4TCA_L4E.XLS

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Leachate
Run Name

Data Input Instructions:
1. Enter value directly...or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable → Data used directly in model.
Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	39.7	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	α_x	15.0	(ft)
Transverse Dispersivity	α_y	1.5	(ft)
Vertical Dispersivity	α_z	0.0	(ft)
or		or	
Estimated Plume Length			(ft)

3. ADSORPTION

Retardation Factor	R	2.5	(-)
or		or	
Soil Bulk Density	ρ_b		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	λ_{1st}	7.4E-1	(per yr)
or		or	
Solute Half-Life	$t_{1/2}$		(year)
or Instantaneous Reaction Model			
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	350	(ft)
Modeled Area Width*	150	(ft)
Simulation Time	17	(yr)

L / W

Variable: 115 or
20

6. SOURCE DATA

Source Thickness in Sat.Zone: 10 (ft)

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones	Width* (ft)	Conc. (mg/L)*
1	0	0
2	0	0
3	20	887
4	0	0
5	0	0

Source Halflife (see Help):

Inst. Reactn	1st Order
7	7 (yr)

Soluble Mass in Source NAPL, Soil: 510 (Kg)

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data, Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	35	70	105	140	175	210	245	280	315	350
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

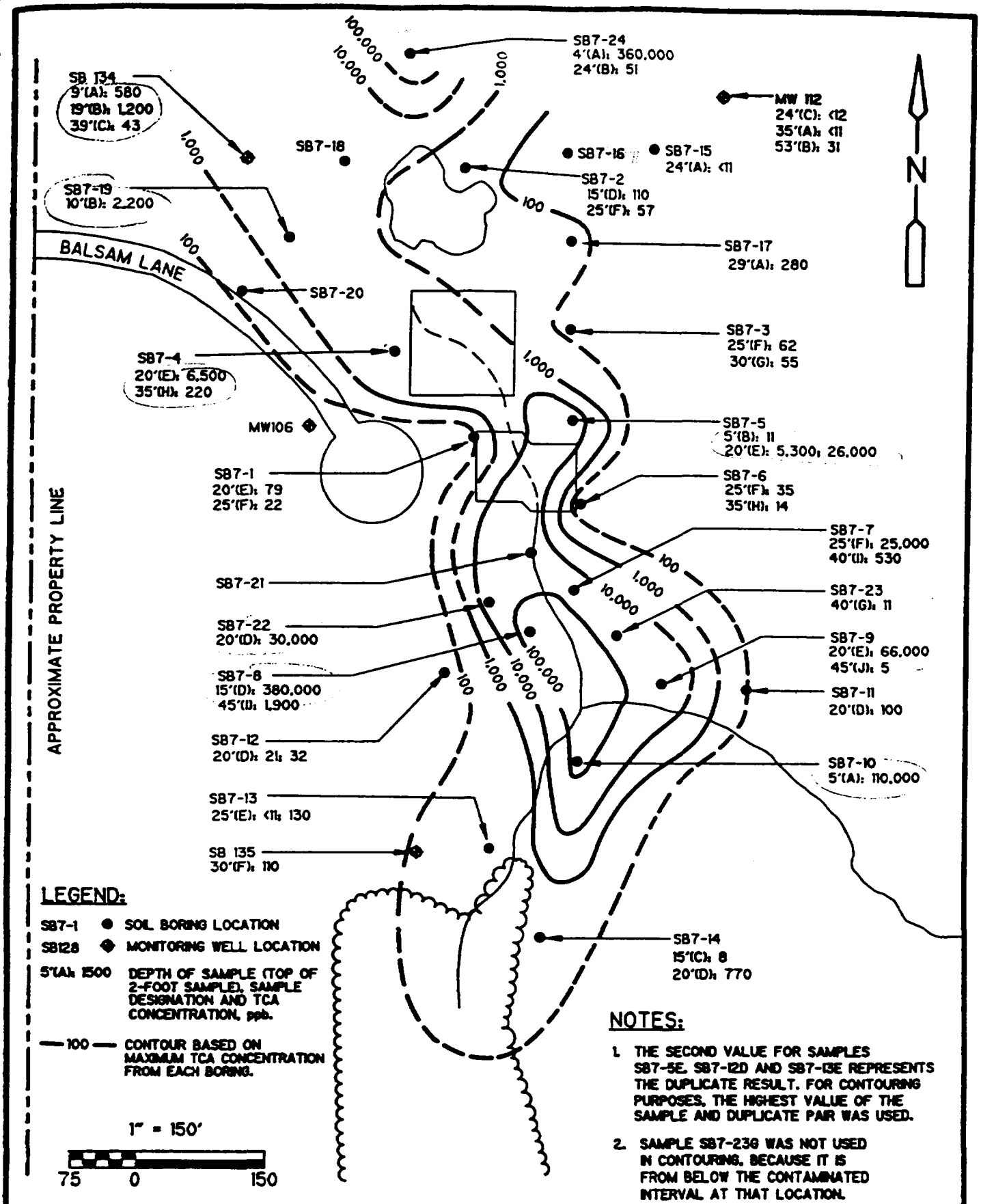
efficiency for air sparging of leachate;
Assume air sparging reduces soil source conc. by 40%;

APPENDIX B.3

AREA 7 INPUT PARAMETERS AND BIOSCREEN OUTPUT

Area 7 Soil Concentrations Used for Soluble Mass Estimate -- BIOSCREEN							
		Concentration (mg/kg)					
		TCA	After Treatment[1]	PCE	TCE	1,2-DCE (Total)	Xylene
SB7-14	C			0.049			
SB7-14	D			24			
SB7-10	A	110		16	5.5	49	210
SB7-9	J	0.005	0.005	0.007	58	0.004	100
SB7-9	E	66		100	0.006	7.2	0.006
SB7-23	G	0.011	0.011	0.014	0.011	0.011	0.011
SB7-7	I	0.53	0.53	0.92	0.34	0.26	0.93
SB7-7	F	25	25	24	10	0.97	18
SB7-5	E	26	26	24	3	8.8	8.9
SB7-5	E	5.3	5.3	8.4	0.63	1.7	3.4
SB7-5	B	0.011	0.011	0.029	0.003	0.005	0.011
SB7-22	D	30	30	8.8	0.96	10	19
SB7-8	D	380		260	130	15	180
SB7-8	I	1.9	1.9	1.2	0.15	1.3	1.2
SB7-4	E	6.5	6.5	17	2.4	0.7	6.2
SB7-4	H	0.22	0.22	0.095	0.66	0.13	0.049
SB7-19	B	2.2	2.2	1.4	1.4	1.4	13
SB134	C	0.043	0.043	0.029	0.013	0.015	0.016
SB134	B	1.2	1.2	0.031	0.008	0.35	1.1
SB134	A	0.58	0.58	1.5	0.59	1.3	0.011
SB7-201		460		23	96	47	190
SB7-202		1.35	1.35	1.35	0.24		9.85
SB7-24	A			110	24	26	110
MEAN CONC.		**55.84**	**6.30**	**27.04**	**15.90**	**8.56**	**41.51**
	n	**20**	**16**	**23**	**21**	**20**	**21**
Volume (ft^3)		3.18E+06	3.18E+06	3.18E+06	3.18E+06	3.18E+06	3.18E+06
L/ft^3 Conv.		28.37	28.37	28.37	28.37	28.37	28.37
Bulk Den.		1.7	1.7	1.7	1.7	1.7	1.7
(kg/L)							
Soil Mass		1.53E+08	1.53E+08	1.53E+08	1.53E+08	1.53E+08	1.53E+08
(kg)							
Mean Contam.		**8,564**	**967**	**4,146**	**2,439**	**1,312**	**6,366**
Mass (kg)							

[1] Assume *soil* treatment (*ex-situ* biopile & thermal desorp.) removes concentrations > 50 mg/kg



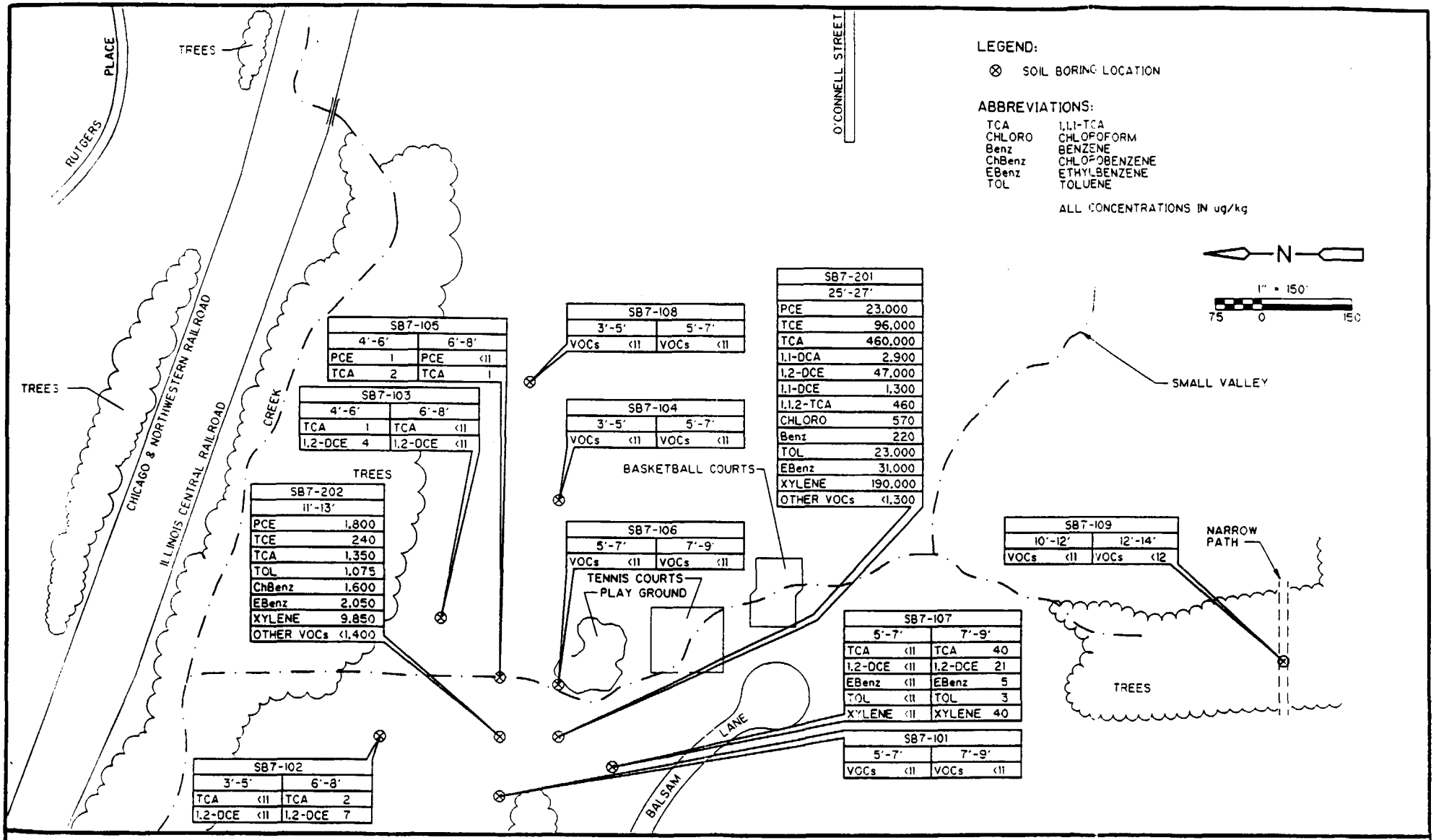
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

TCA IN SUBSURFACE SOILS POTENTIAL SOURCE AREA 7

CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 4-15

I:\CAD\168\17\RIN\RRPT\ FIG4-15 06/02/94 J.S. ALFONSO

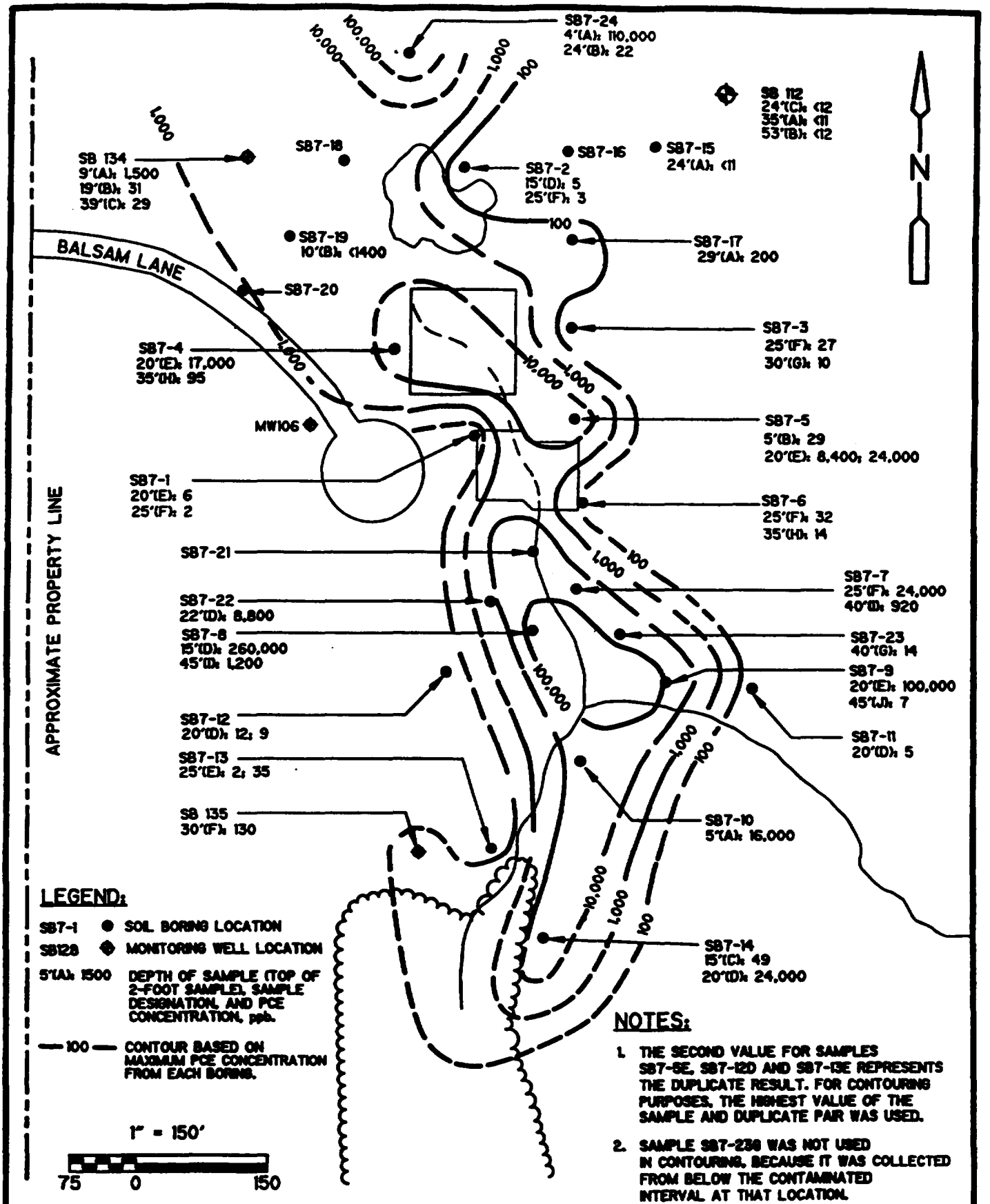


CDM
environmental engineers, scientists, planners, & management consultants

SOUTHEAST ROCKFORD
SOURCE CONTROL OPERABLE UNIT

AREA 7 SUBSURFACE SOIL DATA FOR VOCs

Figure No. 3-10



SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

PCE CONCENTRATION IN SUBSURFACE SOILS POTENTIAL SOURCE AREA 7

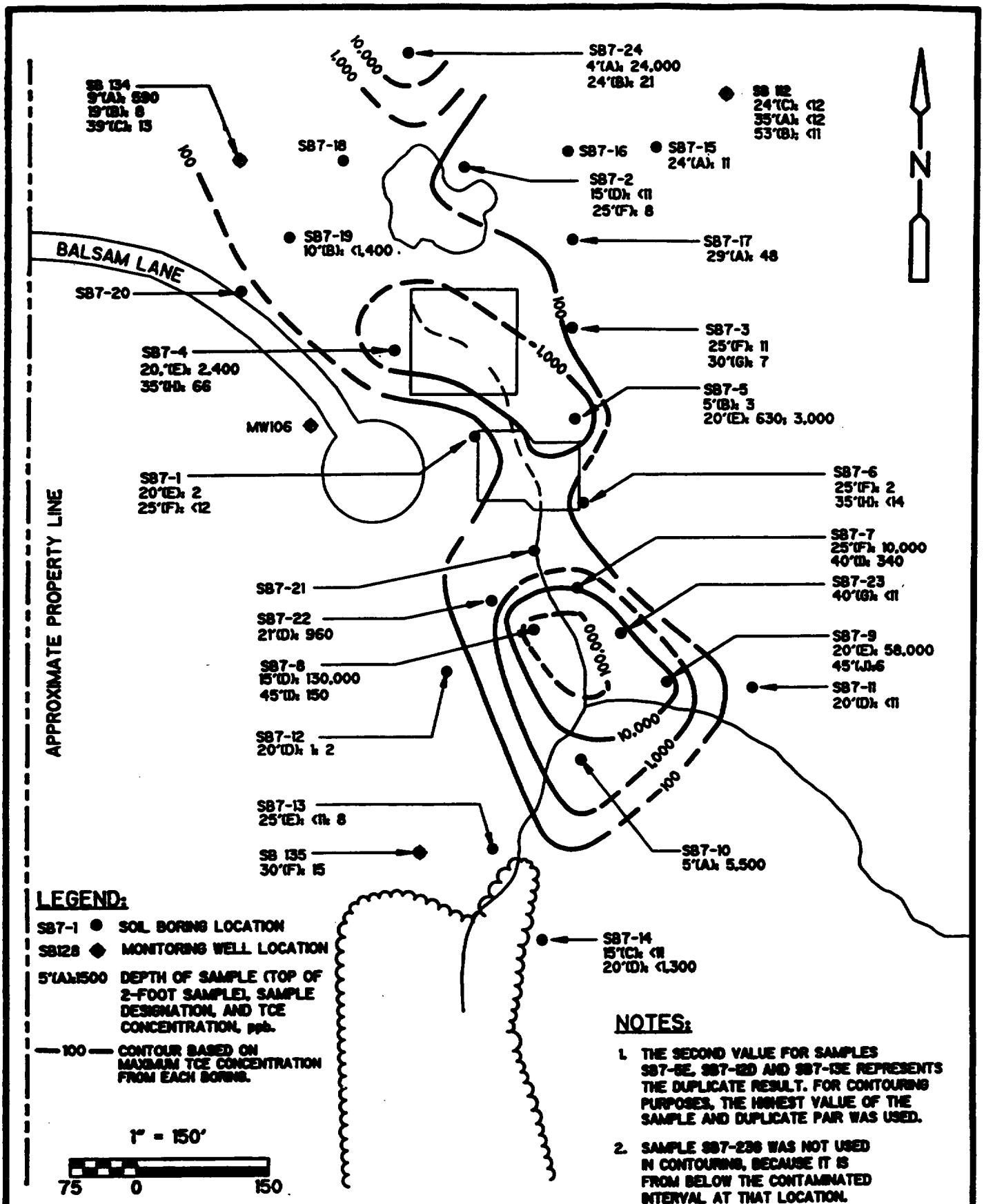
CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 4-16

05/29/94 J.S.ALFONSO

F16-16

I:\CAD\168IL7\RI\RRPT\



SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

TCE CONCENTRATION IN SUBSURFACE SOILS POTENTIAL SOURCE AREA 7

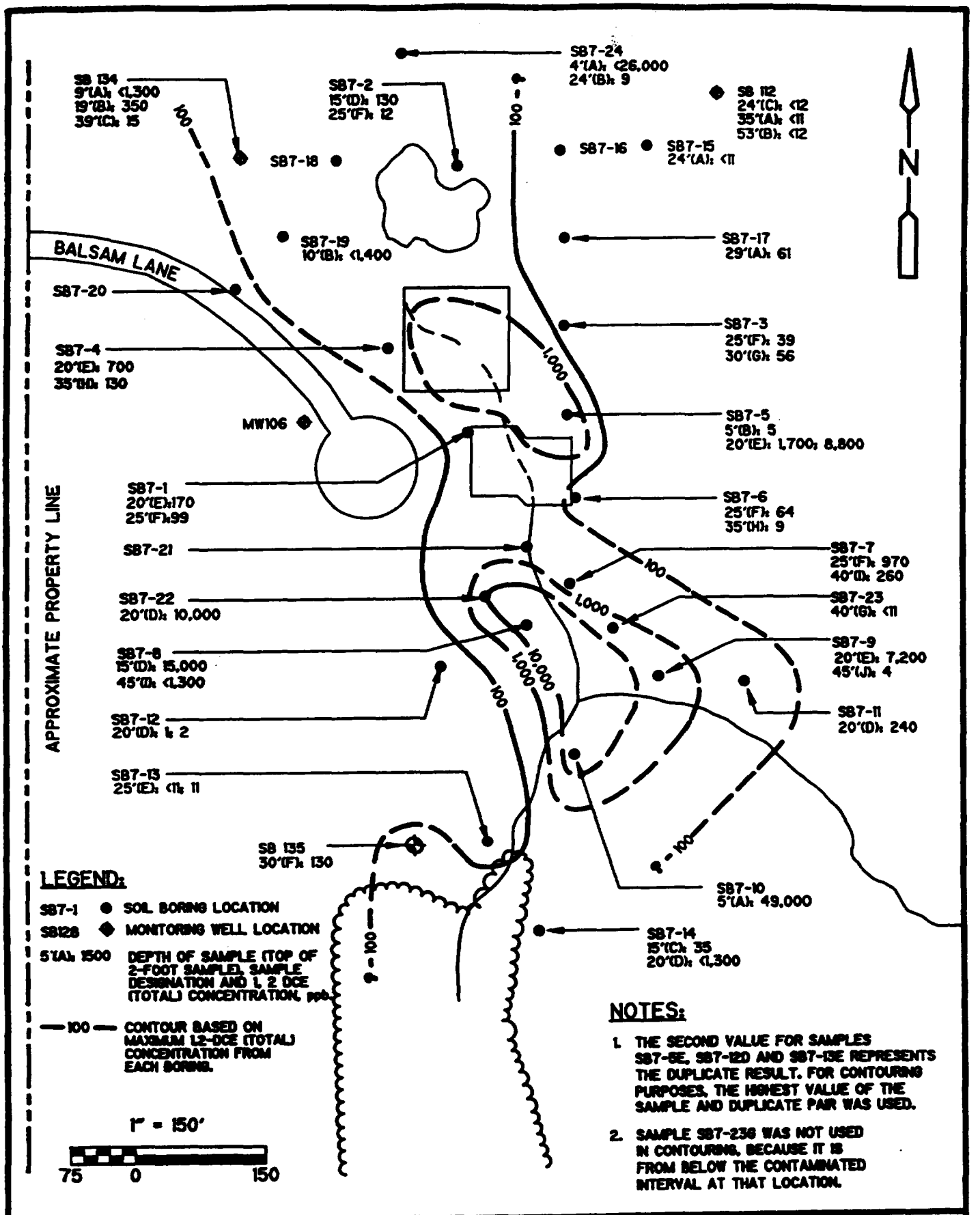
CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 4-17

08/29/94 J.S. ALFONSO

FIG4-17

I:\CAD\GBK\TURNKRPT\



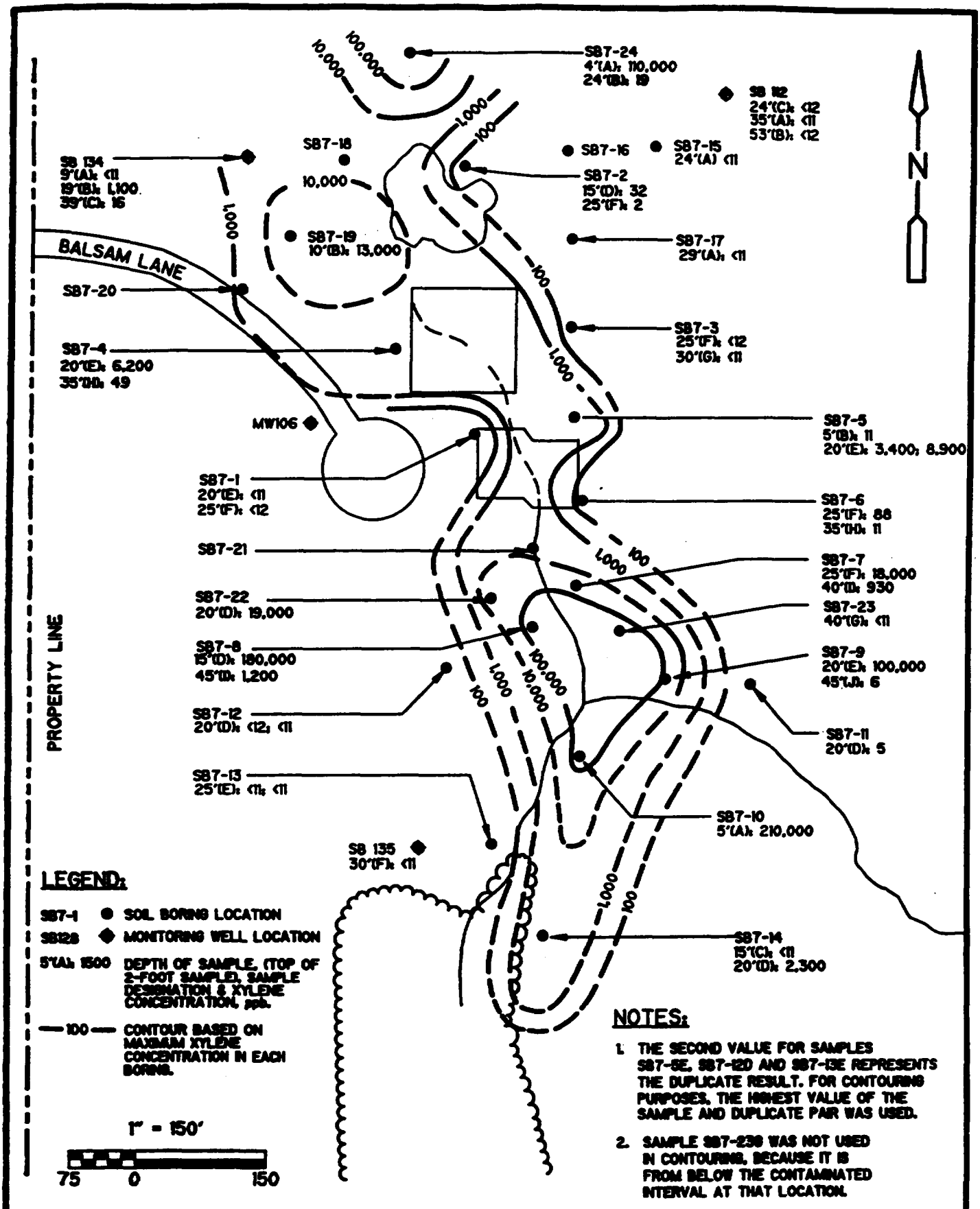
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

1,2-DCE (TOTAL) CONCENTRATION IN SUBSURFACE SOILS POTENTIAL SOURCE AREA 7

CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 4-18

\\CAD\688\7\ARI\RPT\ FIG4-18 05/29/94 J.S. ALFONSO



SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION STUDY

XYLENE CONCENTRATION IN SUBSURFACE SOILS
POTENTIAL SOURCE AREA 7

CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 4-20

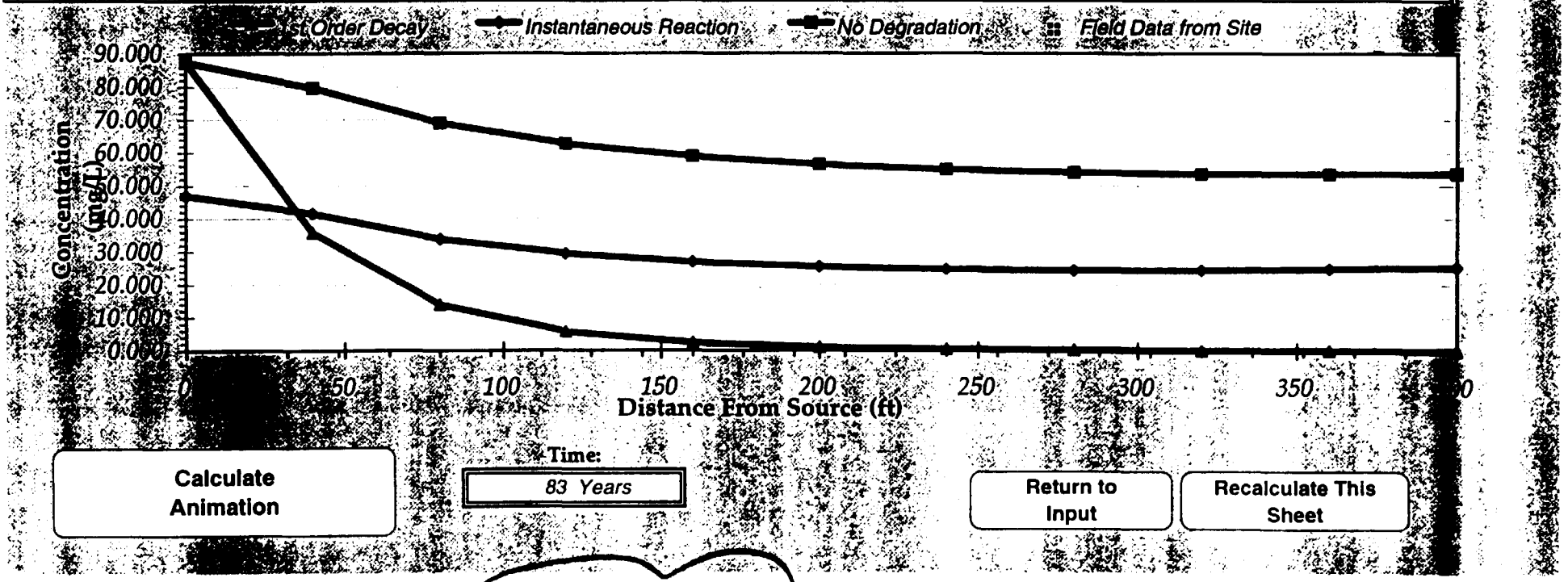
k:\CAD\SB6\7\RI\RPT\ FIG4-20 05/29/94 J.S. ALFONSO

Area 7 TCA -- No Action (SCS-7A) Limited Action (SCS-7B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone 3

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	87.476	79.704	68.913	62.653	58.842	56.445	54.946	54.064	53.632	53.546	53.736
1st Order Decay	87.476	35.775	13.884	5.666	2.388	1.028	0.449	0.198	0.088	0.040	0.018
Inst. Reaction	46.976	41.570	33.782	29.400	26.872	25.420	24.659	24.377	24.451	24.803	25.383
Field Data from Site											



Calculate Animation

Time: 83 Years

Return to Input

Recalculate This Sheet

80-90 yr

7TCA_S7A.XLS

Area 7 TCA -- No Action (SCS-7A) Limited Action (SCS-7B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L present in source zone 3

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--No/Limited Action
Run Name

Data Input Instructions:
115 ▶ 1. Enter value directly...or
or 2. Calculate by filling in grey cells below. (To restore formulas, hit buttons below).
▶ Data used directly by model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity	Vs	62.1	(ft/yr)
or			
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient			(ft/ft)
Porosity			()

2. DISPERSION

Longitudinal Dispersivity	alpha x	35.0	(ft)
Transverse Dispersivity	alpha y	3.5	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or			
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor	R	2.9	()
or			
Soil Bulk Density	rhob		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		()

4. BIODEGRADATION

1st Order Decay Coefficient	lambda	7.4E-1	(per yr)
or			
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2	16.6	(mg/L)
Delta Sulfate	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	83	(yr)

L, W

Variable* ▶ Data used directly by model.
20 ▶ Value calculated by model. (Don't enter any data).

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Vertical Plume Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones	Width* (ft)	Conc. (mg/L)*
1	0	0
2	100	5
3	50	887
4	100	5
5	0	0

Source Halflife (see Help):

Inst. React.	1st Order
20	20 (yr)

Soluble Mass 8564 (Kg)
In Source NAPL, Soil

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

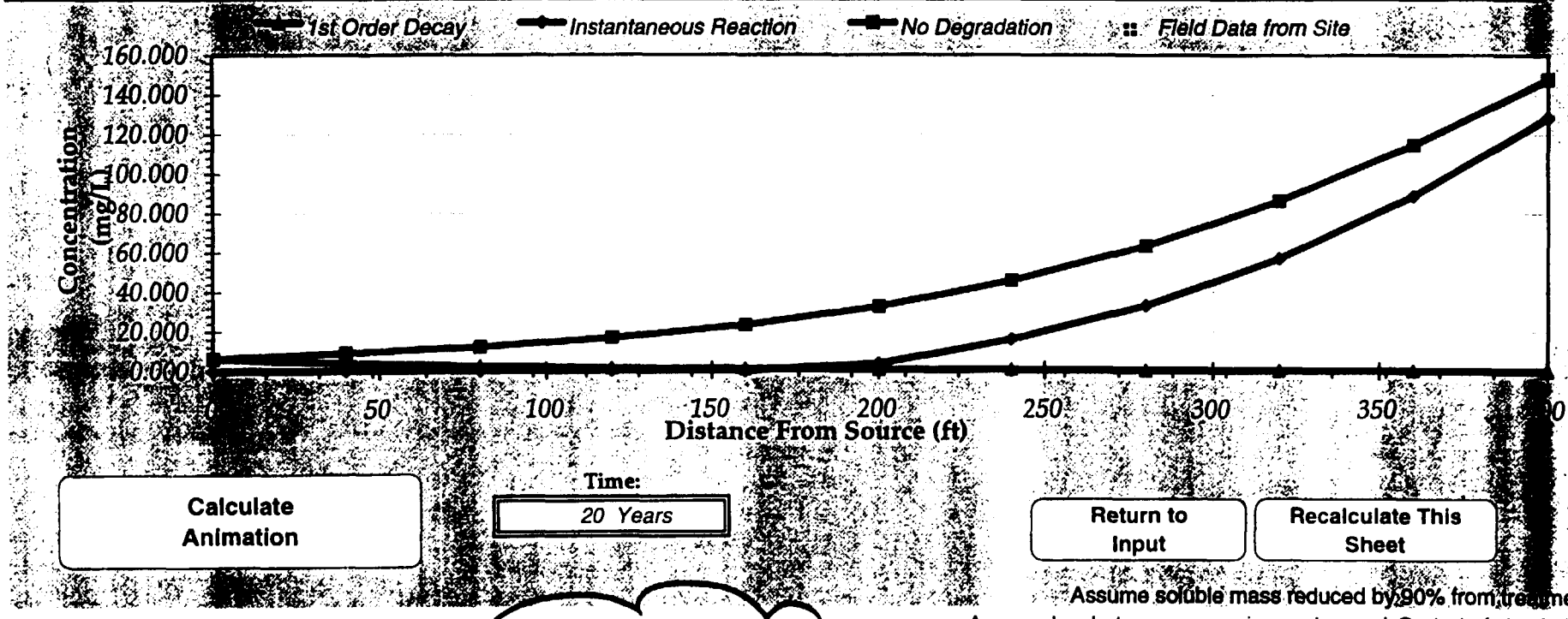
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	6.324	9.068	12.077	16.533	23.066	32.423	45.483	63.145	86.115	114.572	147.799
1st Order Decay	6.324	3.845	2.171	1.266	0.758	0.462	0.286	0.178	0.112	0.071	0.045
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	3.487	15.607	32.970	56.967	88.699	128.480
Field Data from Site											



Calculate Animation

Time: 20 Years

Return to Input

Recalculate This Sheet

Assume soluble mass reduced by 90% from treatment;
Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

15 - 25 yr.

7TCA_S7C.XLS

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Exsitu Bio
Run Name

Data Input Instructions:

115 ▶ 1. Enter value directly...or
or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable* → Data used directly in model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	26.9	(ft)
Transverse Dispersivity	alpha y	2.7	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor	R	2.9	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coefficient	lambda	7.4E-1	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	20	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
100	5
50	887
100	5
0	0

Source Halflife (see Help): 3 (yr)

Inst. React. / 1st Order

Soluble Mass 967 (Kg)
In Source NAPL Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3

View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

Recalculate This Sheet

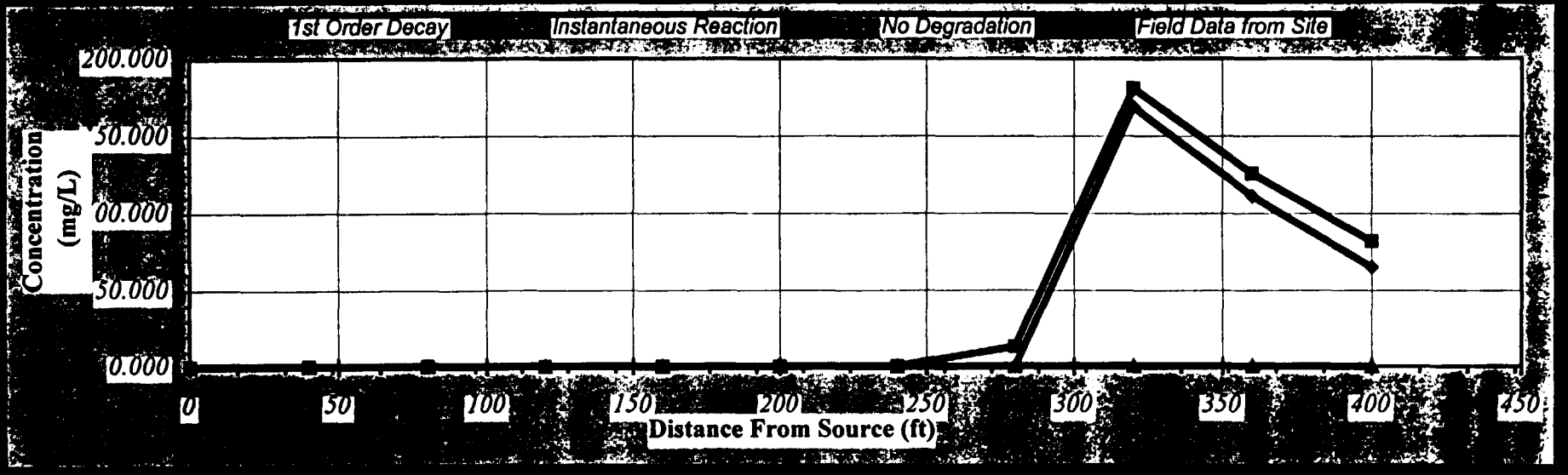
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

Assume soluble mass reduced by 90% from treatment;
Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

Area 7 TCA -- Thermal Desorption (SCS-7D)

0.000	0.000	0.000	0.000	0.000	0.001	0.099	13.051	180.797	125.725	81.834
0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.054	0.404	0.161	0.064
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	168.795	111.132	64.990



Calculate Animation

14 Years

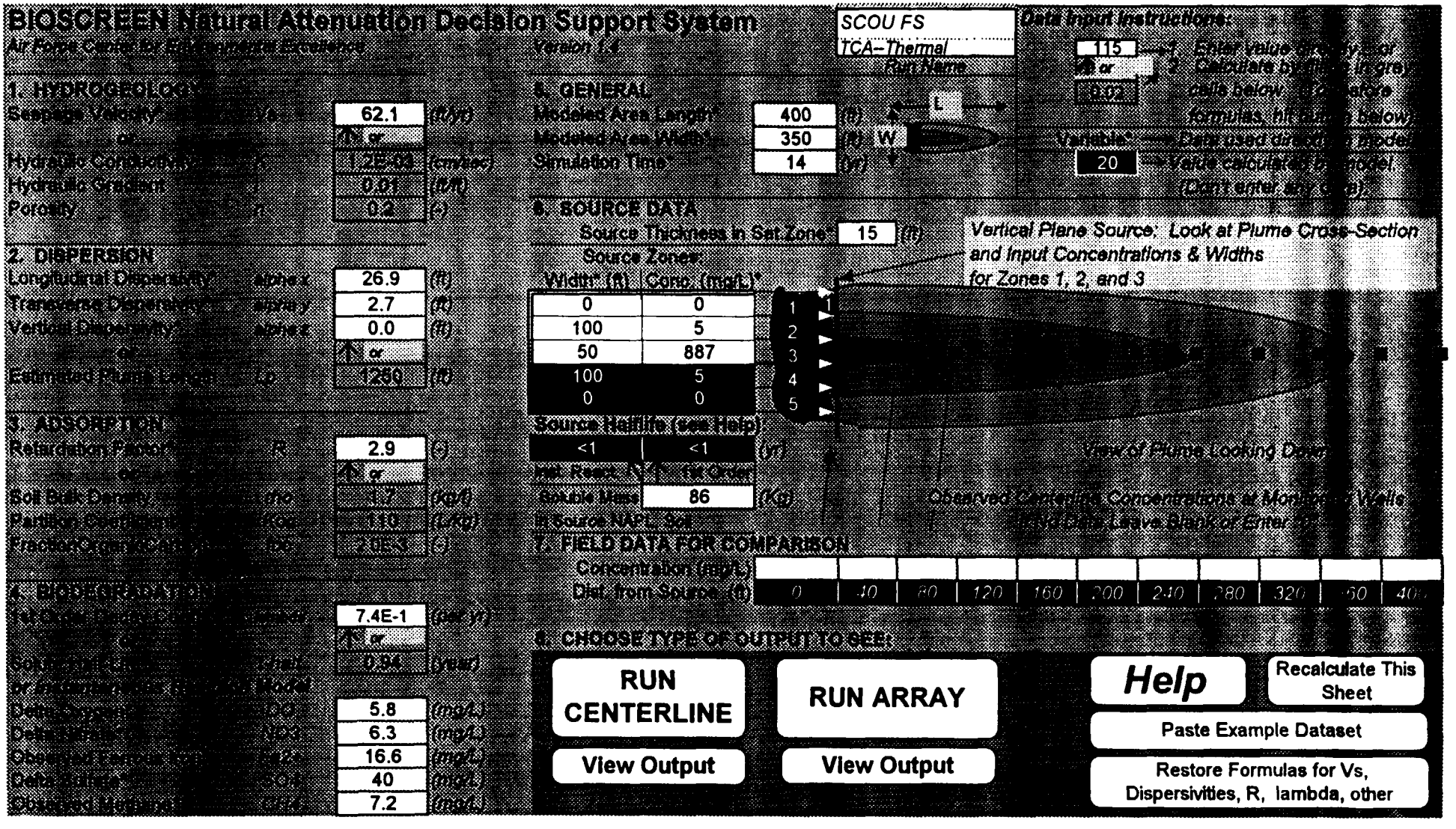
Return to Input

Recalculate This Sheet

Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

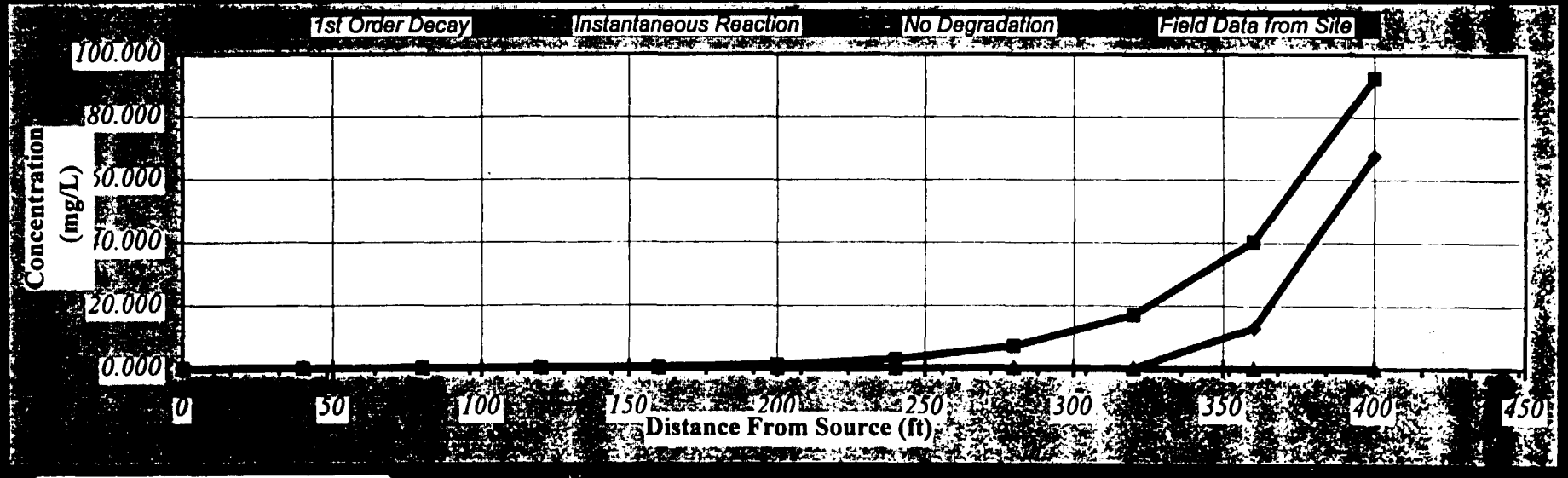
7tca_s7d.xls

10 - 20 yrs.



Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

	0.013	0.032	0.076	0.184	0.456	1.141	2.845	7.024	17.034	40.301	92.448
	0.013	0.014	0.014	0.014	0.015	0.016	0.018	0.020	0.022	0.025	0.028
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.953	67.514



Calculate Animation

20 Years

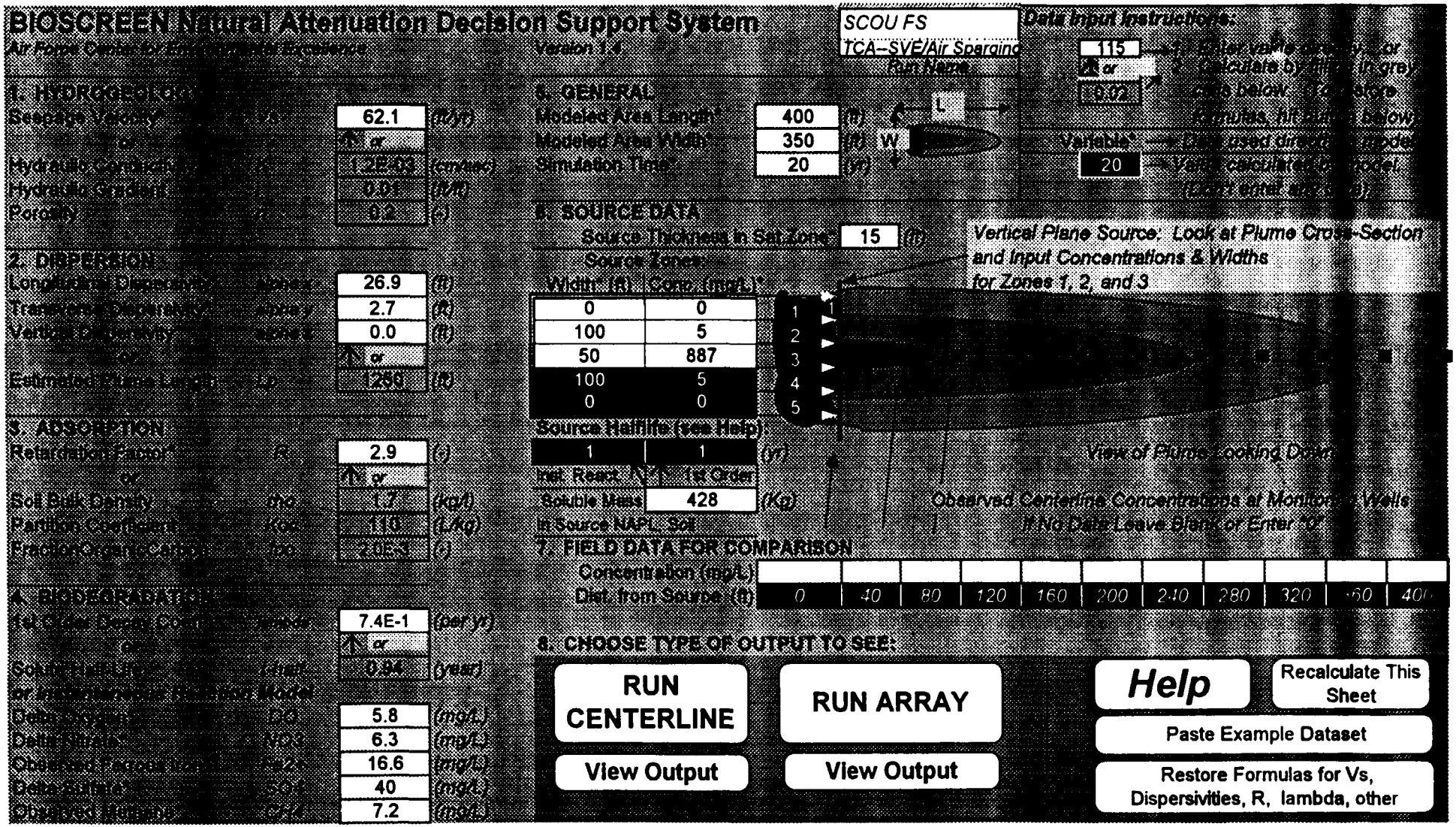
Return to Input

Recalculate This Sheet

Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

7tca_s7e.xls

15-25 yrs.



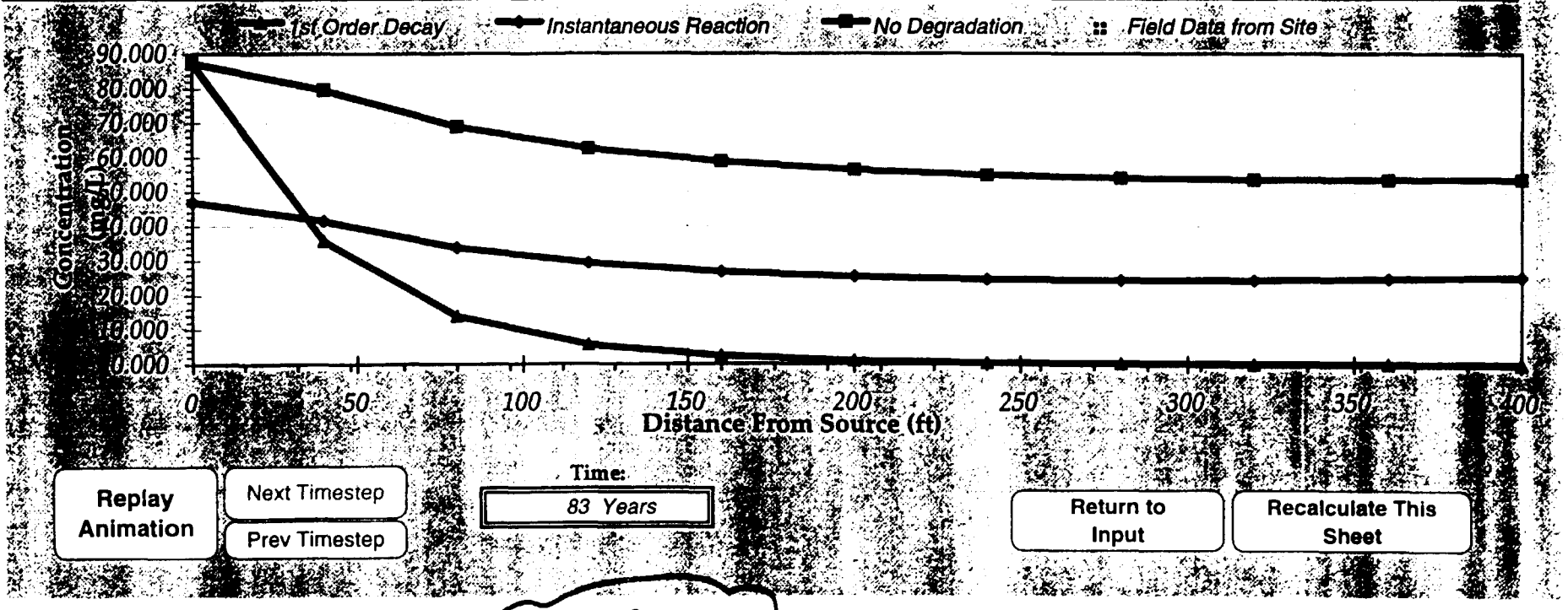
Assume soluble mass reduced by 95% from treatment;
Assume leachate conc. remains unchanged @ start of simulation;
plume length decreased by 50%;

Area 7 TCA -- No Action (SCL-7A)
Assume mean conc. of 2/3 solubility of 1,330 mg/L

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	87.476	79.704	68.913	62.653	58.842	56.445	54.946	54.064	53.632	53.546	53.736
1st Order Decay	87.476	35.775	13.884	5.666	2.388	1.028	0.449	0.198	0.088	0.040	0.018
Inst. Reaction	46.976	41.570	33.782	29.400	26.872	25.420	24.659	24.377	24.451	24.803	25.383
Field Data from Site											



80-90 yr

7TCA_L7A.XLS

Area 7 TCA -- No Action (SCL-7A)
Assume mean conc. of 2/3 solubility of 1,330 mg/L

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--No Action
Run Name

Data Input Instructions:
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable* ▶ Data used directly by model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	35.0	(ft)
Transverse Dispersivity	alpha y	3.5	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION*

Retardation Factor	R	2.9	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	7.4E-1	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	83	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Source Zones:

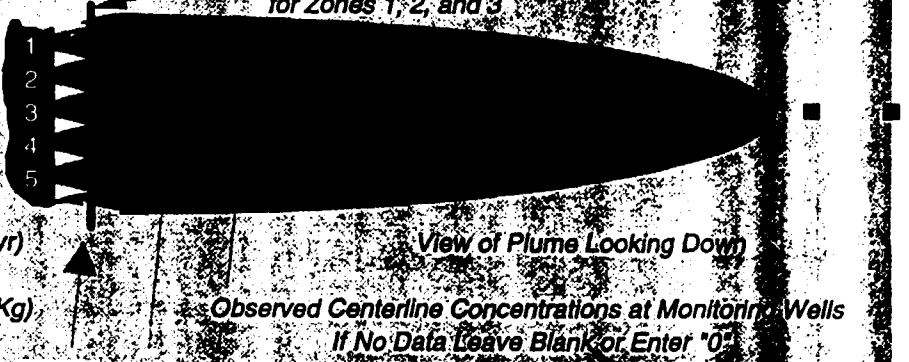
Width* (ft)	Conc. (mg/L)*
0	0
100	5
50	887
100	5
0	0

Source Halflife (see Help):

Inst. Reactn	1st Order
20	20 (yr)

Soluble Mass 8564 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

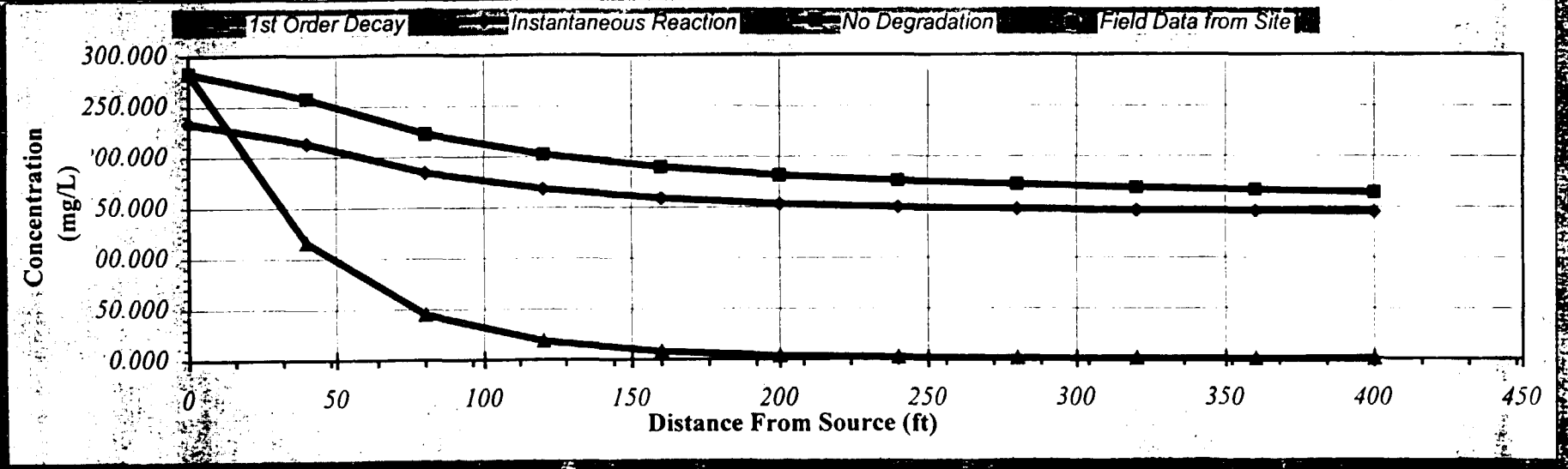
7TCA_L7A.XLS

Area 7 TCA -- MPE in Source Area + Air Stripping @ GMZ Boundary (SCL-7B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L and 15% removal efficiency for leachate in Source Area

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L)

Distance from Source (ft)

TYPE OF DECAY	0	40	80	120	160	200	240	280	320	360	400
No Degradation	282.773	257.505	222.584	202.207	189.618	181.411	175.840	171.889	168.885	166.327	163.804
1st Order Decay	282.773	115.689	44.918	18.338	7.733	3.331	1.456	0.643	0.287	0.128	0.058
Inst. Reaction	233.269	213.294	184.493	168.232	158.722	153.025	149.625	147.631	146.436	145.577	144.660
Field Data from Site											



Calculate Animation

35 Years

Return to Input

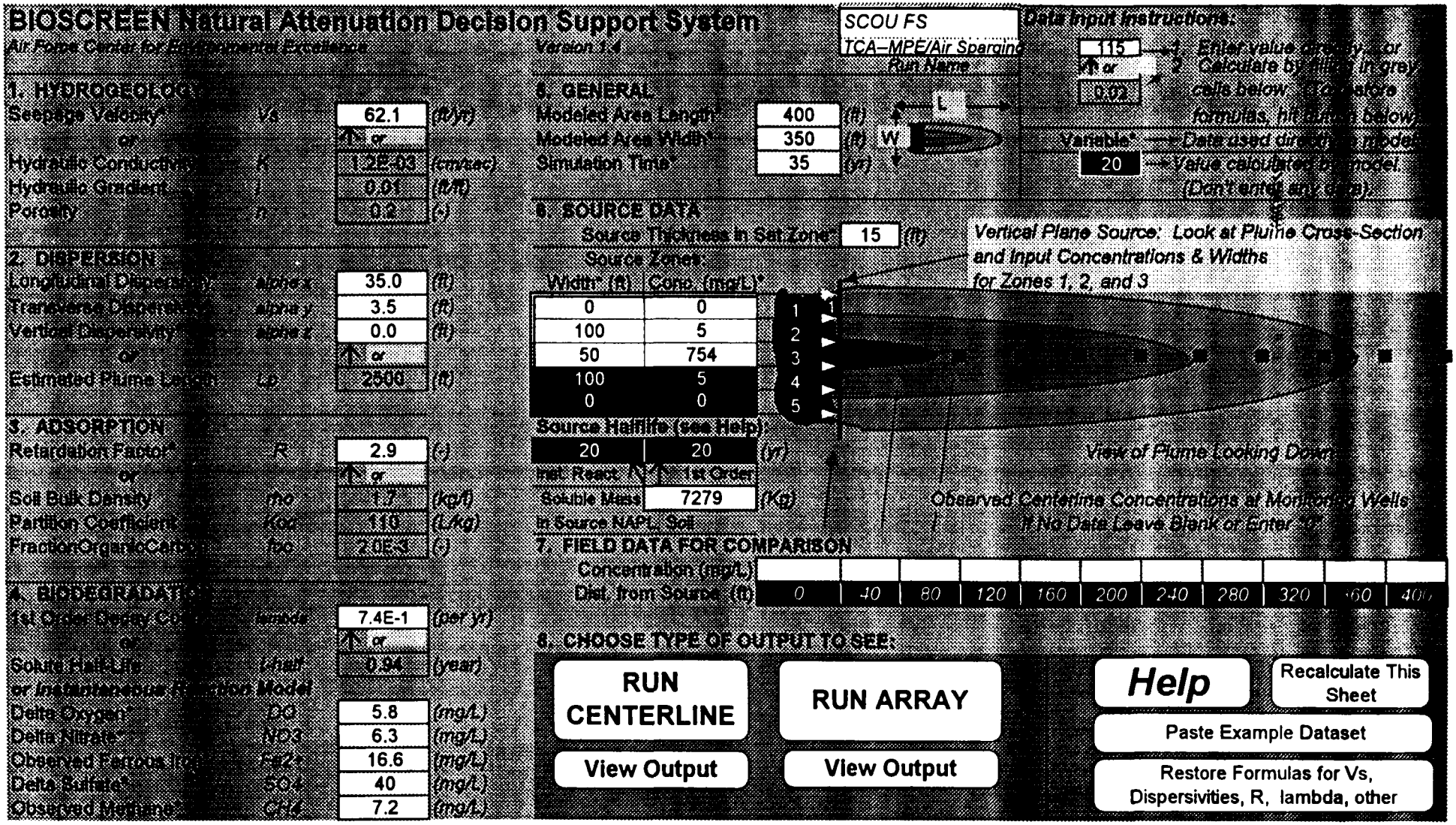
Recalculate This Sheet

7tca_l7b.xls

30-40 yrs.

Assume 70% efficiency for air stripping;
Assume 15% removal efficiency for MPE in soil and leachate in source area;

Area 7 TCA -- MPE in Source Area + Air Stripping @ GMZ Boundary (SCL-7B)
Assume mean conc. of 2/3 solubility of 1,330 mg/L and 15% removal efficiency for leachate in Source Area

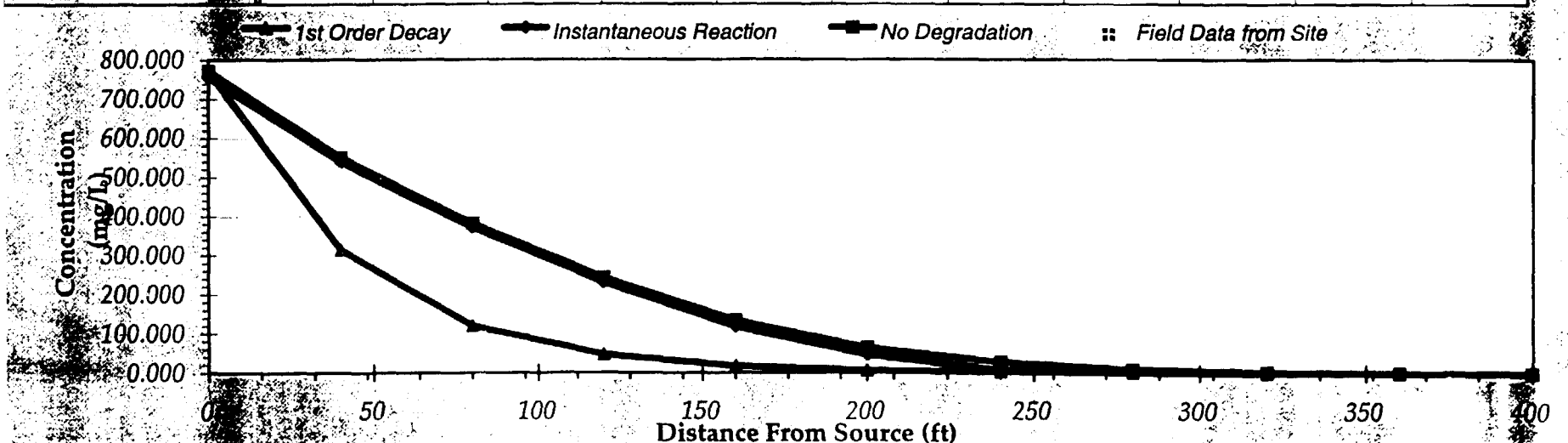


Assume 70% efficiency for air stripping;
Assume 15% removal efficiency for MPE in soil and leachate in source area;

Area 7 TCA -- Reactive Barrier Wall (SCL-7C)
Assume mean conc. of 2/3 solubility of 1,330 mg/L

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	40	80	120	160	200	240	280	320	360	400
No Degradation	771.470	550.467	380.929	242.631	133.844	64.442	26.561	9.247	2.694	0.652	0.131
1st Order Decay	771.470	313.693	120.074	46.553	17.229	6.078	1.975	0.574	0.145	0.032	0.006
Inst. Reaction	755.990	538.642	370.737	230.642	118.173	45.957	6.328	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 5 Years

Return to Input

Recalculate This Sheet

5 yr.

7TCA_L7C.XLS

Area 7 TCA -- Reactive Barrier Wall (SCL-7C)
Assume mean conc. of 2/3 solubility of 1,330 mg/L

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCA--Barrier Wall
Run Name

Data Input Instructions:

115 or [ ]
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	35.0	(ft)
Transverse Dispersivity*	alpha y	3.5	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	2.9	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

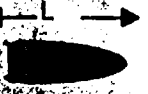
1st Order Decay Coef	lambda	7.4E-1	(per yr)
or		or	
Solute Half-Life	t-half		(year)

or Instantaneous Reaction Model

Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	5	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

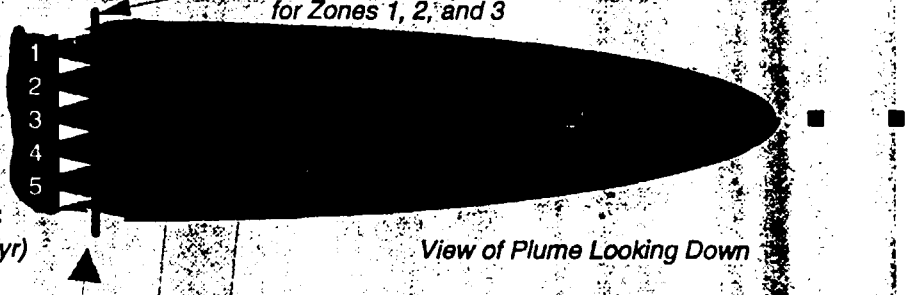
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
100	5
50	887
100	5
0	0

Source Halflife (see Help):

20	20	(yr)
Inst. React:	1st Order	
Soluble Mass	8564	(Kg)
In Source NAPL, Soil		

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

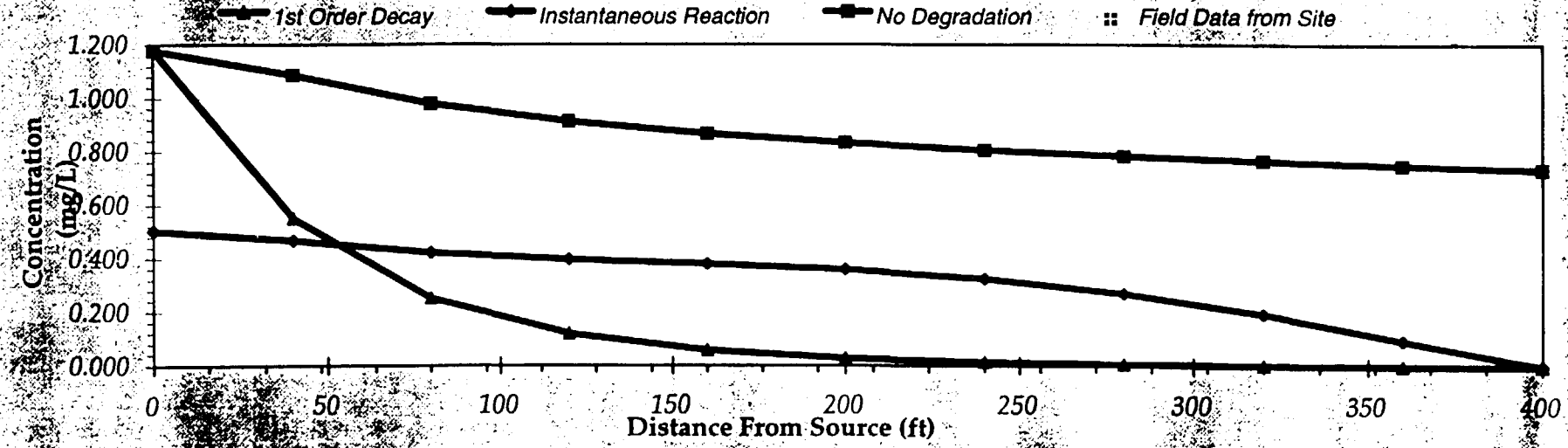
7TCA_L7C.XLS

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	1.179	1.087	0.980	0.913	0.868	0.834	0.808	0.786	0.767	0.750	0.735
1st Order Decay	1.179	0.551	0.252	0.119	0.057	0.028	0.014	0.007	0.003	0.002	0.001
Inst. Reaction	0.504	0.468	0.422	0.397	0.381	0.360	0.325	0.270	0.194	0.097	0.000
Field Data from Site											

0.005



Calculate Animation

Time: 85 Years

Return to Input

Recalculate This Sheet

80-90 yr

7PCE_S7A.XLS

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
PCE--No/Limited Action
Run Name

Data Input Instructions:
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		or	
Hydraulic Conductivity*	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n(e)		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	35.0	(ft)
Transverse Dispersivity*	alpha y	3.5	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	3.6	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	4.6E-1	(per yr)
or		or	
Solute Half-Life	thalf		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	85	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

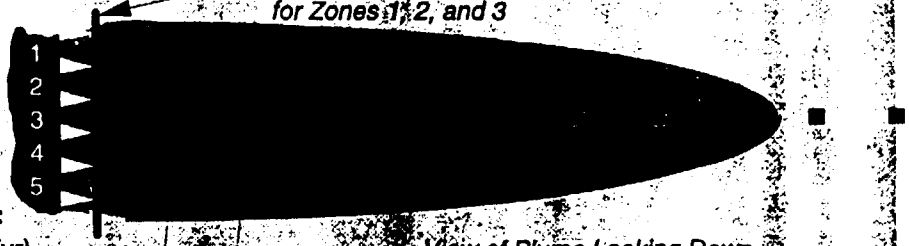
Source Zones:

	Width* (ft)	Conc. (mg/L)*
1	0	0
2	100	0.5
3	50	1.2
4	100	0.5
5	0	0

Source Halflife (see Help):

100	>1000	(yr)
Inst. Reactn.	1st Order	
Soluble Mass	4146	(Kg)
In Source NAPL, Soil		

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)											
Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

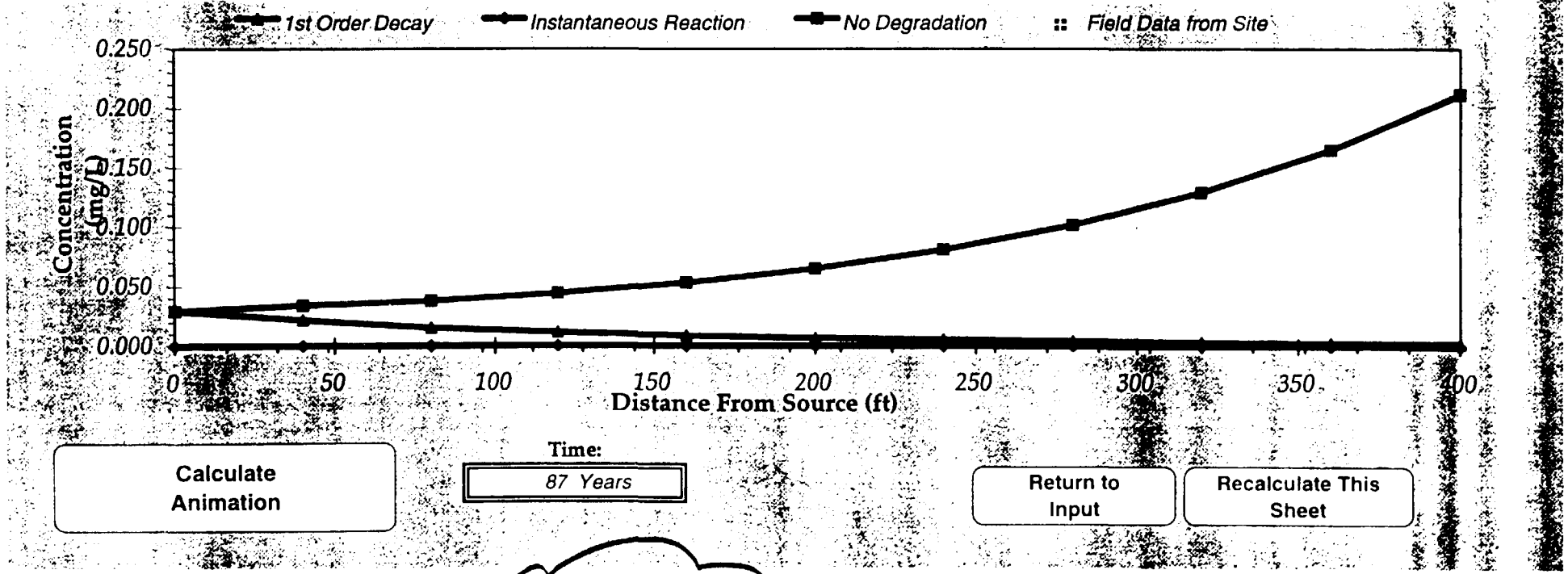
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	0.029	0.034	0.038	0.044	0.053	0.065	0.081	0.102	0.129	0.165	0.212
1st Order Decay	0.029	0.022	0.015	0.011	0.009	0.007	0.005	0.004	0.003	0.003	0.002
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 87 Years

Return to Input

Recalculate This Sheet

80-90 yr

7TCE_S7A.XLS

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

SCOU FS
TCE--No/Limited Action
Run Name

Data Input Instructions:

115 ▶ 1. Enter value directly ... or
or ▶ 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable* ▶ Data used directly in model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOG

Seepage Velocity*	Vs	62.1	(ft/yr)
or		*or*	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	35.0	(ft)
Transverse Dispersivity	alpha y	3.5	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor	R	3.8	(-)
or		*or*	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATI

1st Order Decay Co	lambda	2.6E-1	(per yr)
or		*or*	
Solute Half-life	thalf		(year)
or Instantaneous Reaction	Model		
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Ir	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	87	(yr)

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

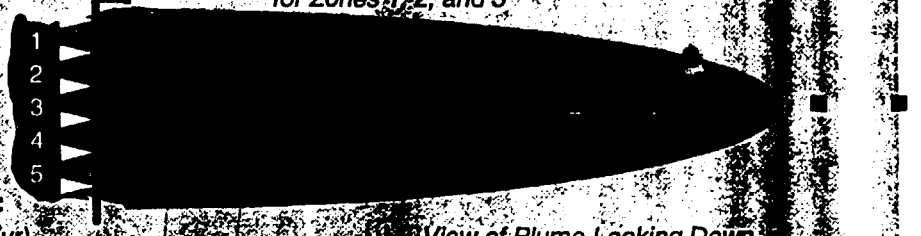
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
100	5
50	1100
100	5
0	0

Source Halflife (see Help):

Inst. React.	1st Order	
5	6	(yr)
Soluble Mass	2439	(Kg)
In Source NAPL, Soil		

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

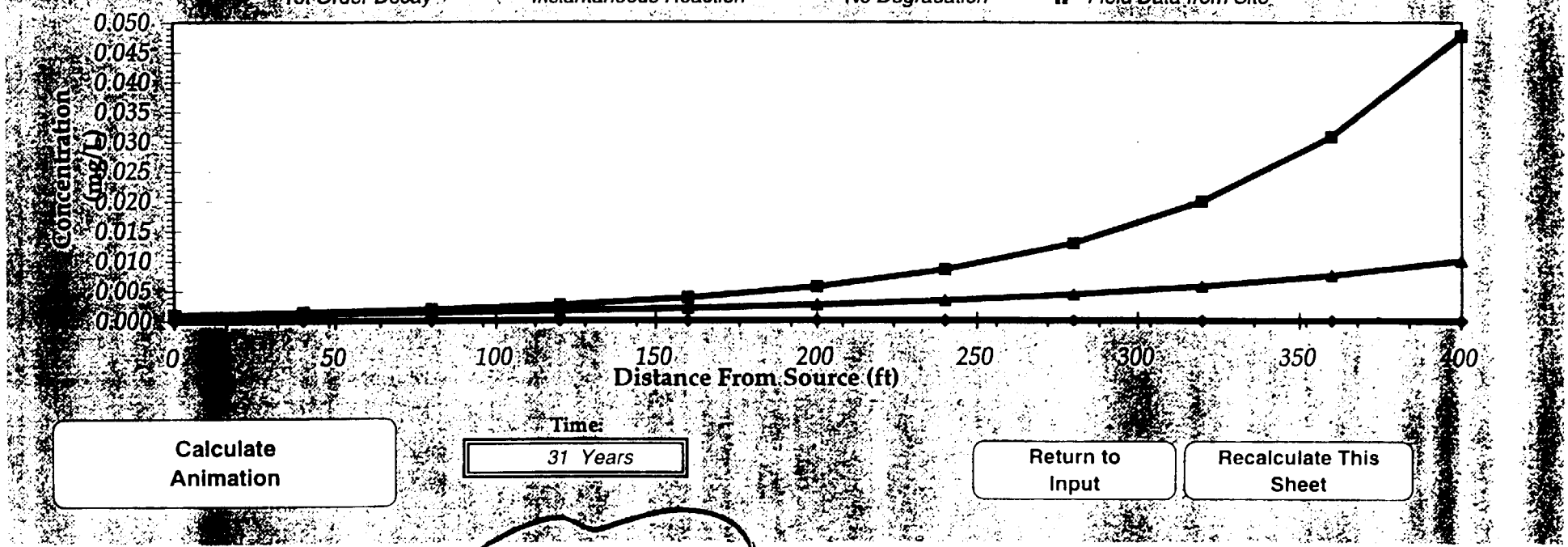
Restore Formulas for Vs, Dispersivities, R, lambda, other

Area 7 1,2-DCE (Total) -- No Action (SCS-7A) Limited Action (SCS-7B)

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	40	80	120	160	200	240	280	320	360	400
No Degradation	0.001	0.001	0.002	0.003	0.004	0.006	0.009	0.013	0.020	0.031	0.048
1st Order Decay	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.006	0.008	0.010
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 31 Years

Return to Input

Recalculate This Sheet

25-35 yr

7DCE_S7A.XLS

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
1,2-DCE--No/Limited Action
Run Name

Data Input Instructions:

115 or [ ] ▶ 1: Enter value directly...or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

! Variable* ▶ Data used directly in model.

20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		or	
Hydraulic Conductivity	K	[ ]	(cm/sec)
Hydraulic Gradient	I	[ ]	(ft/ft)
Porosity	n	[ ]	(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	35.0	(ft)
Transverse Dispersivity	alpha y	3.5	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		or	
Estimated Plume Length*	Lp	[ ]	(ft)

3. ADSORPTION

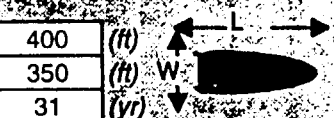
Retardation Factor*	R	1.6	(-)
or		or	
Soil Bulk Density	rho	[ ]	(kg/l)
Partition Coefficient	Koc	[ ]	(L/kg)
Fraction Organic Carbon	foc	[ ]	(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	1.7E-1	(per yr)
or		or	
Solute Half-Life	t-half	[ ]	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	31	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Source Zones:

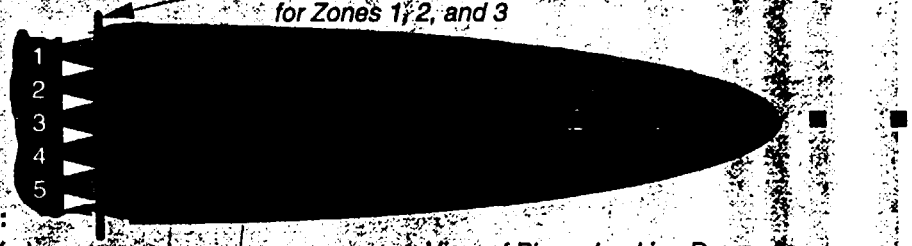
Width* (ft)	Conc. (mg/L)*
0	0
100	5.9
50	2333
100	5.9
0	0

Source Halflife (see Help):

Inst. React.	1st Order	
1	1	(yr)

Soluble Mass in Source NAPL, Soil: 1312 (Kg)

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	40	80	120	160	200	240	280	320	360	400
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

Recalculate This Sheet

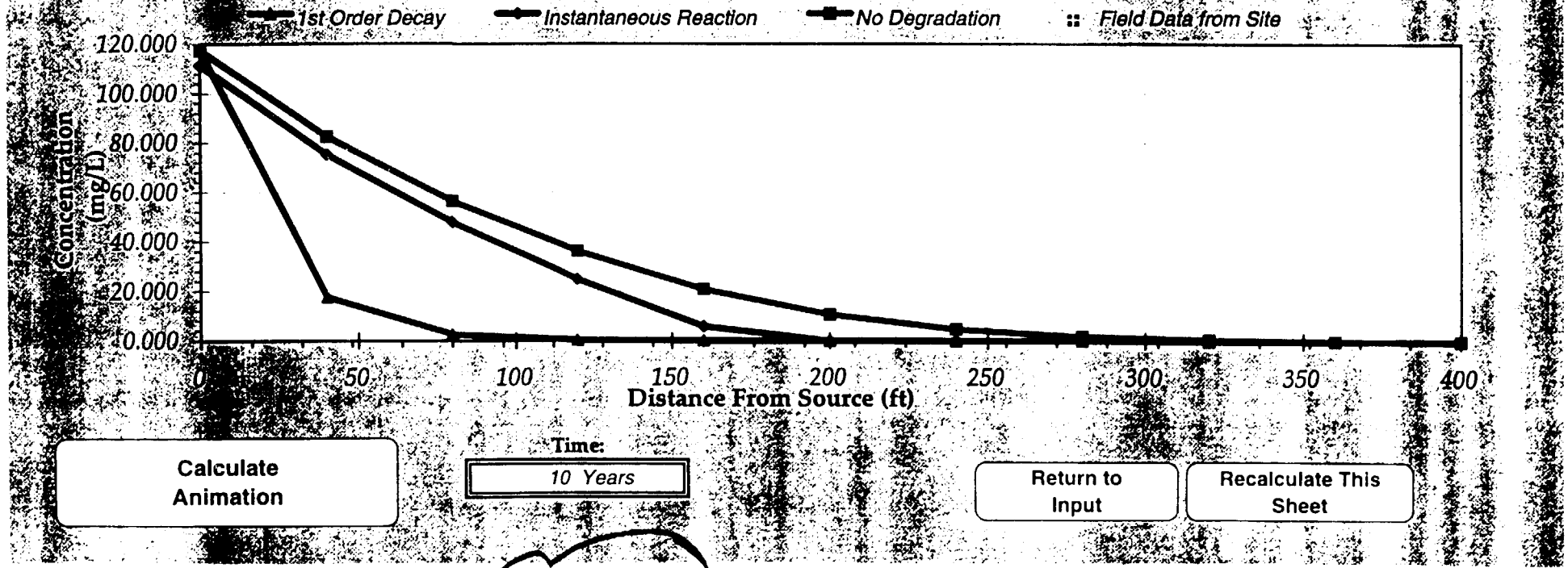
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

7DCE_S7A.XLS

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	40	80	120	160	200	240	280	320	360	400
No Degradation	117.581	82.679	56.437	36.261	20.815	10.549	4.631	1.738	0.552	0.148	0.033
1st Order Decay	117.581	17.736	2.539	0.381	0.058	0.009	0.001	0.000	0.000	0.000	0.000
Inst. Reaction	111.358	75.355	47.894	24.917	5.797	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 10 Years

Return to Input

Recalculate This Sheet

< 10 yr

7XYL_S7A.XLS

BIOSCREEN: Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence

Version 1.4

SCOU FS
Xylene--No/Limited Action
Run Name

Data Input Instructions:

115 *or*

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ← *Data used directly in model.*

20 ← *Value calculated by model.*

(Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	62.1	(ft/yr)
or		*or*	
Hydraulic Conductivity*	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	35.0	(ft)
Transverse Dispersivity*	alpha y	3.5	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor*	R	5.4	(-)
or		*or*	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

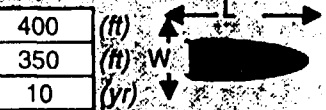
1st Order Decay Coeff*	lambda	1.3E+0	(per yr)
or		*or*	
Solute Half-Life	t-half		(year)

or Instantaneous Reaction Model

Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	400	(ft)
Modeled Area Width*	350	(ft)
Simulation Time*	10	(yr)



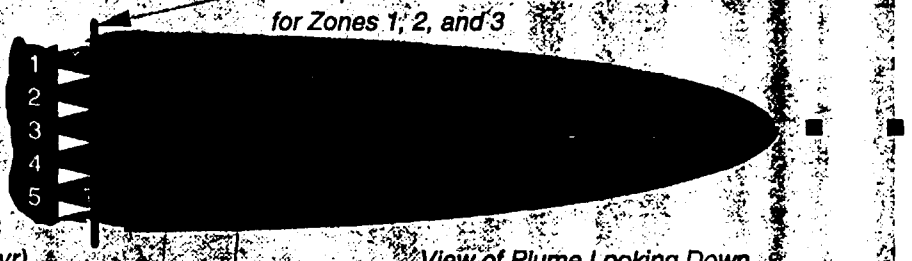
6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
100	1.1
50	124
100	1.1
0	0

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Source Halflife (see Help):

Inst. Reaction	1st Order
70	100 (yr)

Soluble Mass 6366 (Kg)
In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	Concentration (mg/L)
0	
40	
80	
120	
160	
200	
240	
280	
320	
360	
400	

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

APPENDIX B.4

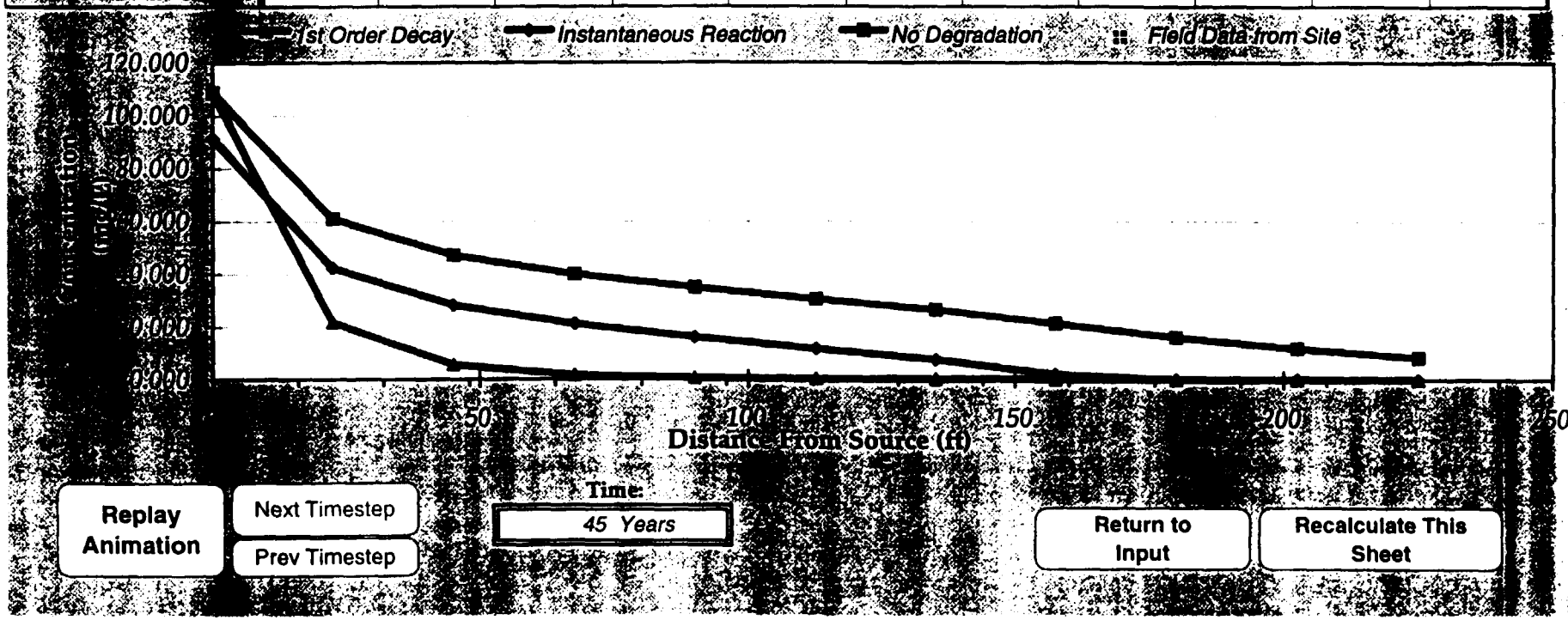
AREA 9/10 INPUT PARAMETERS AND BIOSCREEN OUTPUT

Area 9/10W Soil Concentrations Used for Soluble Mass Estimate -- BIOSCREEN							
(Data from IEPA file on Sundstrand Plant #1)							
	Concentration (mg/kg)						
	PCE						
VE-1	47						
VE-2	0.53	0.53					
VE-3	1000						
VE-4	2900						
TRENCH #1	100						
TRENCH #2	3500						
TRENCH #3	1.4	1.4					
MEAN CONC. (mg/kg)	**1,078**	43.5					
n	**7**						
Volume (ft^3)	2.00E+03	2.00E+03					
L/ft^3 Conv.	28.37	28.37					
Bulk Den.	1.7	1.7					
(kg/L)							
Soil Mass	9.65E+04	9.65E+04					
(kg)							
Mean Contam.	**104**	**4**	[a]				**0**
Mass (kg)							
[a] Mean contaminant mass if two lowest sample concentrations are included							

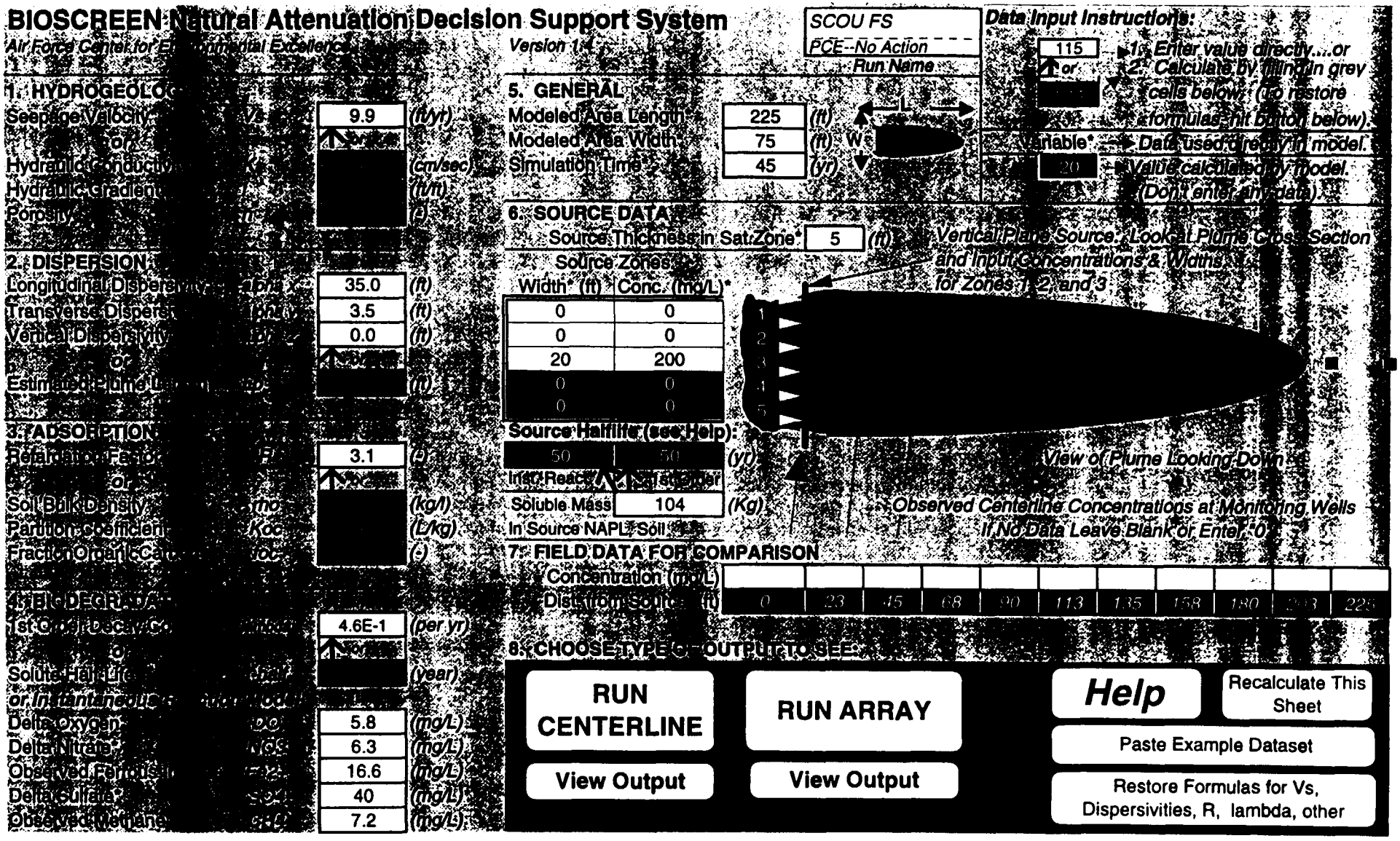
Area 9/10W PCE -- No Action (SCS-9/10A and SCS-9/10B)
Assume mean conc. of PCE solubility of 200 mg/L present in source zone

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODE	0	23	45	68	90	113	135	158	180	203	225
No Degrad[illegible]	108.873	60.944	47.049	39.839	34.705	30.340	26.272	21.090	15.929	11.698	8.325
1st Order [illegible]	108.873	21.567	5.529	1.584	0.478	0.148	0.047	0.014	0.004	0.001	0.000
[illegible]	91.334	42.256	28.199	20.999	15.889	11.509	7.362	1.736	0.000	0.000	0.000
Field Data from [illegible]											



Area 9/10W PCE -- No Action (SCS-9/10A and SCS-9/10B)
Assume mean conc. of PCE solubility of 200 mg/L present in source zone



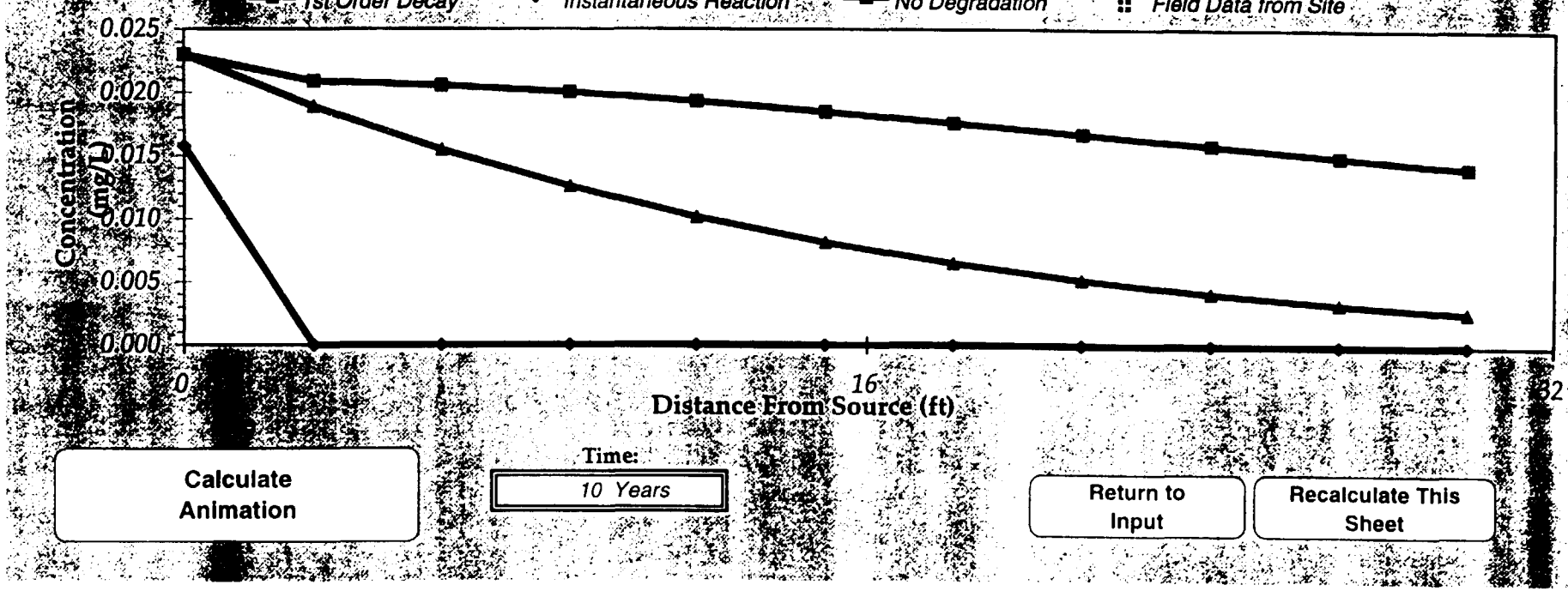
Area 11 Soil Concentrations Used for Soluble Mass Estimate -- BIOSCREEN								
	Concentration (mg/kg)							
	Benzene	Xylene	Ethylbenzene	Toluene	TCE		Methylene Chloride	2-Methylphenol
SB11-1		200	56	930	55		0.013	0.47
SB11-5		530	150	230	27		55	0.39
SB11-6						0.012		0.39
SB11-7		310	64	150	0.41		1.3	0.4
SB11-8						1.5	2.9	0.4
SB11-10		2300	590	1400	0.011		1.4	0.37
SB11-101						0.01	0.01	
SB11-110						0.011	0.011	
SB128		980	240	470	1.4		1.4	0.39
SB11-202		650	120	180	27		27	
SB11-203		110	20	180	13		13	
MEAN CONC. (mg/kg)	**1500.00**	**725.71**	**177.14**	**505.71**	**17.69**		**10.20**	**0.4**
n	**0**	**7**	**7**	**7**	**7**		**10**	
Volume[a] (ft^3)	2.37E+05	2.37E+05	2.37E+05	2.37E+05	2.37E+05		2.37E+05	2.37E+05
L/ft^3 Conv.	28.37	28.37	28.37	28.37	28.37		28.37	28.37
Bulk Den. (kg/L)	1.7	1.7	1.7	1.7	1.7		1.7	1.7
Soil Mass (kg)	1.14E+07	1.14E+07	1.14E+07	1.14E+07	1.14E+07		1.14E+07	1.14E+07
Mean Contam. Mass (kg)	**17,110**	**8,278**	**2,021**	**5,769**	**202**		**116**	**5**
[a] Contaminated soil volume from Appendix C								

APPENDIX B-4
AREA 11 INPUT PARAMETERS AND BIOSCREEN OUTPUT

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	3	6	9	12	15	18	21	24	27	30
No Degrad[illegible]	0.023	0.021	0.021	0.020	0.019	0.018	0.018	0.017	0.016	0.015	0.014
1st Order D[illegible]y	0.023	0.019	0.015	0.013	0.010	0.008	0.006	0.005	0.004	0.003	0.003
Inst. Reac[illegible]	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from [illegible]											



Time:
10 Years

Calculate Animation

Return to Input

Recalculate This Sheet

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
Benzene--No Action
Run Name

Data Input Instructions:

115 ▶ 1. Enter value directly....or
or 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).
Variable* ▶ Data used directly in model.
20 ◀ Value calculated by model. (Don't enter any data)

1. HYDROGEOLOG

Seepage Velocity*	Vs	9.9	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient			(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	13.8	(ft)
Transverse Dispersivity	alpha y	1.4	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

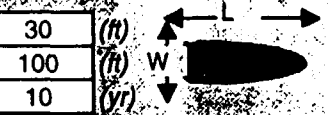
Retardation Factor	R	1.8	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carb	foc		(-)

4. BIODEGRADATI

1st Order Decay Co	lambda	6.9E-1	(per yr)
or		or	
Solute Half-Life	half-		(year)
or Instantaneous	ion Model		
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Ir	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	30	(ft)
Modeled Area Width*	100	(ft)
Simulation Time*	10	(yr)

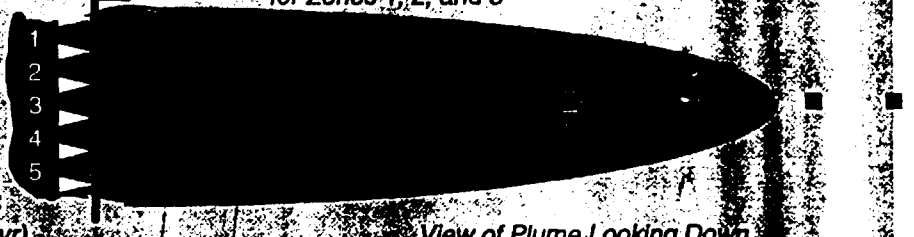


6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones: Width* (ft)	Conc. (mg/L)*
0	0
0	0
25	0.023
0	0
0	0



View of Plume Looking Down

Source Halflife (see Help):

>1000	>1000	(yr)
Inst. React.	1st Order	

Soluble Mass in Source NAPL, Soil: 17000 (Kg)

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	3	6	9	12	15	18	21	24	27	30
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

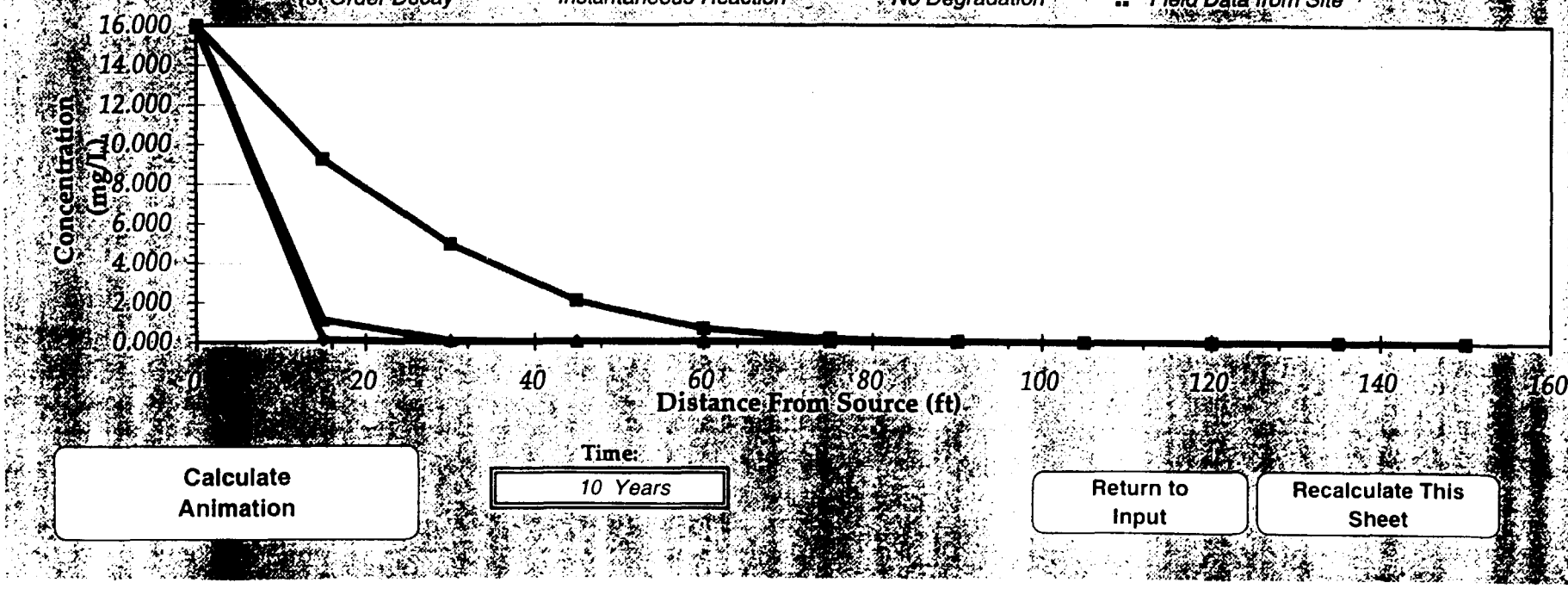
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	15	30	45	60	75	90	105	120	135	150
No Degradation	15.992	9.252	4.926	2.053	0.650	0.152	0.026	0.003	0.000	0.000	0.000
1st Order Decay	15.992	1.129	0.074	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	15.955	0.123	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 10 Years

Return to Input

Recalculate This Sheet

BIOSCREEN: Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
Xylene--No Action
Run Name

Data Input Instructions:

115 or [ ]
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	9.9	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity	alpha x	13.8	(ft)
Transverse Dispersivity	alpha y	1.4	(ft)
Vertical Dispersivity	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

Retardation Factor	R	4.5	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carb.	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	1.3E+0	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen	DO	5.8	(mg/L)
Delta Nitrate	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length	150	(ft)
Modeled Area Width	100	(ft)
Simulation Time*	10	(yr)

L, W

6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Source Zones:

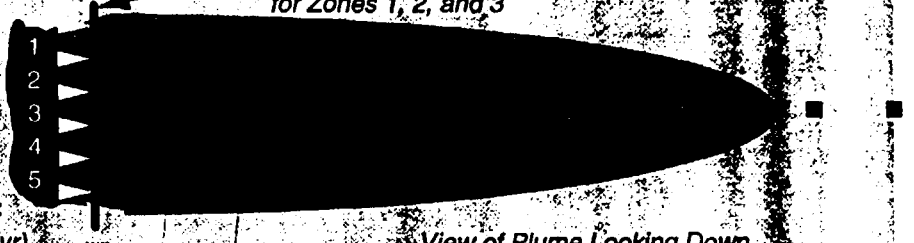
Width* (ft)	Conc. (mg/L)*
0	0
0	0
25	16
0	0
0	0

Source Halflife (see Help):

>1000	>1000	(yr)
Inst. Reaction	1st Order	

Soluble Mass 8278 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	15	30	45	60	75	90	105	120	135	150
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

Recalculate This Sheet

Paste Example Dataset

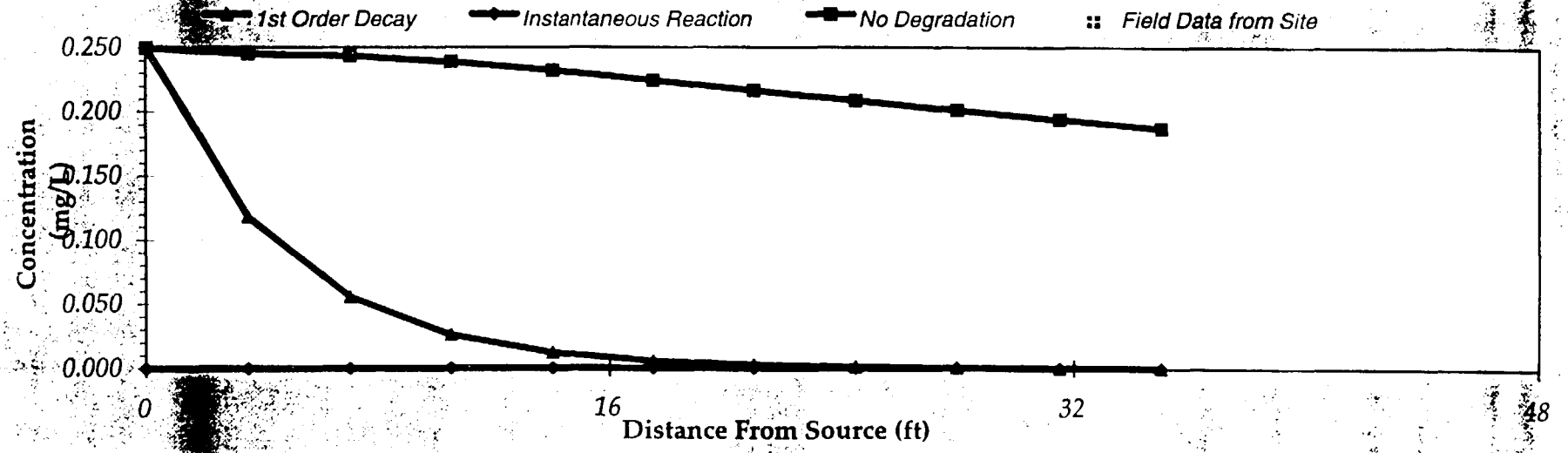
Restore Formulas for Vs, Dispersivities, R, lambda, other

11X_S11A.XLS

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	4	7	11	14	18	21	25	28	32	35
No Degradation	0.250	0.245	0.243	0.239	0.232	0.224	0.217	0.209	0.201	0.194	0.187
1st Order Decay	0.250	0.118	0.056	0.026	0.012	0.006	0.003	0.001	0.001	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Time:

15 Years

Calculate Animation

Return to Input

Recalculate This Sheet

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
Methylene Chloride--No Action (Run Name)

Data Input Instructions:
1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	9.9	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	13.8	(ft)
Transverse Dispersivity*	alpha y	1.4	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

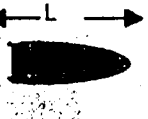
Retardation Factor*	R	1.2	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
FractionOrganicCarbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	7.2E+0	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	35	(ft)
Modeled Area Width*	100	(ft)
Simulation Time*	15	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

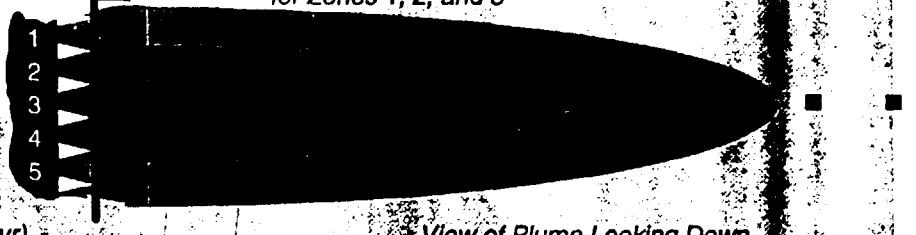
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
0	0
25	0.25
0	0
0	0

Source Halflife (see Help): 100 (Inst. React.) | >1000 (1st Order) (yr)

Soluble Mass 116 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	4	7	11	14	18	21	25	28	32	35
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

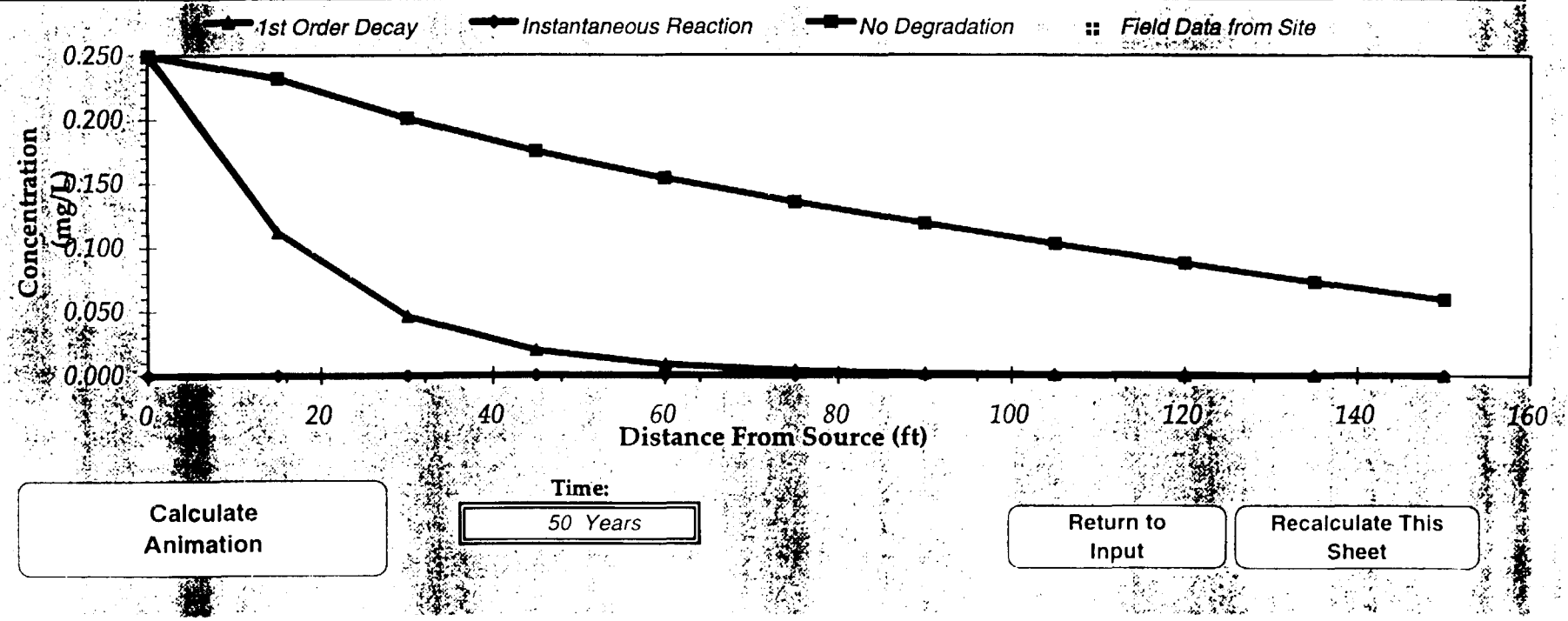
Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	15	30	45	60	75	90	105	120	135	150
No Degradation	0.250	0.232	0.201	0.175	0.154	0.136	0.119	0.103	0.088	0.073	0.059
1st Order Decay	0.250	0.112	0.046	0.019	0.008	0.004	0.002	0.001	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 50 Years

Return to Input

Recalculate This Sheet

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
TCE--No Action
Run Name

Data Input Instructions:

115 or
1. Enter value directly...or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	9.9	(ft/yr)
or		or	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	13.8	(ft)
Transverse Dispersivity*	alpha y	1.4	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		or	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

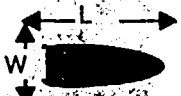
Retardation Factor*	R	3.3	(-)
or		or	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
FractionOrganicCarbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coef.	lambda	2.6E-1	(per yr)
or		or	
Solute Half-Life	t-half		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane*	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	150	(ft)
Modeled Area Width*	100	(ft)
Simulation Time*	50	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

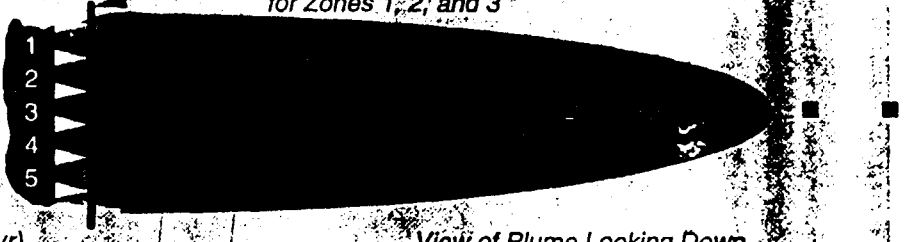
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
0	0
25	0.25
0	0
0	0

Source Halflife (see Help): 200 | >1000 (yr)
Inst. React: | 1st Order

Soluble Mass 202 (Kg)
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	15	30	45	60	75	90	105	120	135	150
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

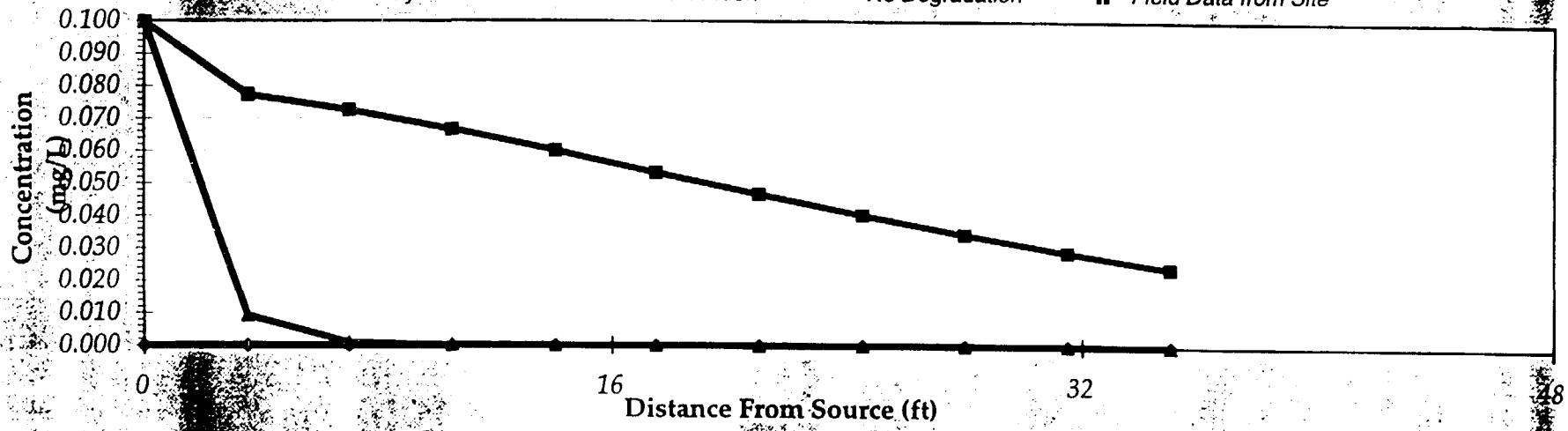
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	4	7	11	14	18	21	25	28	32	35
No Degradation	0.100	0.077	0.073	0.067	0.060	0.053	0.047	0.040	0.034	0.029	0.024
1st Order Decay	0.100	0.009	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site											



Calculate Animation

Time: 5 Years

Return to Input

Recalculate This Sheet

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

SCOU FS
2-Methylphenol--No Action
Run Name

Data Input Instructions:
1. Enter value directly...or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* — ▶ Data used directly in model.
20 ▶ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	9.9	(ft/yr)
or		*or*	
Hydraulic Conductivity	K		(cm/sec)
Hydraulic Gradient	I		(ft/ft)
Porosity	n		(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	13.8	(ft)
Transverse Dispersivity*	alpha y	1.4	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		*or*	
Estimated Plume Length	Lp		(ft)

3. ADSORPTION

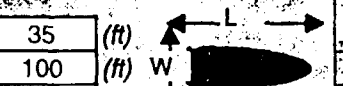
Retardation Factor*	R	2.2	(-)
or		*or*	
Soil Bulk Density	rho		(kg/l)
Partition Coefficient	Koc		(L/kg)
Fraction Organic Carbon	foc		(-)

4. BIODEGRADATION

1st Order Decay Coefficient*	lambda	3.2E+1	(per yr)
or		*or*	
Solute Half-Life	thalf		(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	5.8	(mg/L)
Delta Nitrate*	NO3	6.3	(mg/L)
Observed Ferrous Iron*	Fe2+	16.6	(mg/L)
Delta Sulfate*	SO4	40	(mg/L)
Observed Methane	CH4	7.2	(mg/L)

5. GENERAL

Modeled Area Length*	35	(ft)
Modeled Area Width*	100	(ft)
Simulation Time*	5	(yr)



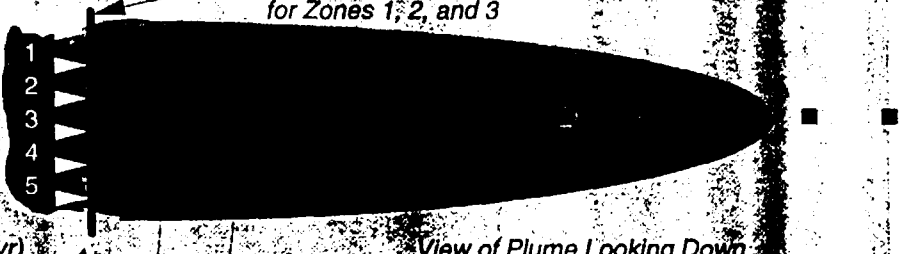
6. SOURCE DATA

Source Thickness in Sat.Zone* 15 (ft)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3

Source Zones:

	Width* (ft)	Conc. (mg/L)*
1	0	0
2	0	0
3	25	0.1
4	0	0
5	0	0



View of Plume Looking Down

Source Halflife (see Help):

6 (yr) — Inst. React. / >1000 1st Order

Soluble Mass 5 (Kg) In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Dist. from Source (ft)	0	4	7	11	14	18	21	25	28	32	35
Concentration (mg/L)											

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

11MPH11A.XLS